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# *Chemical Engineering*

DECEMBER 1966

THE FUTURE OF THE CHEMICAL

ENGINEER

IN

THE

COMING

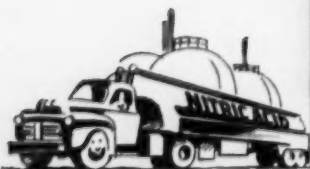


**NUCLEAR  
INDUSTRY**



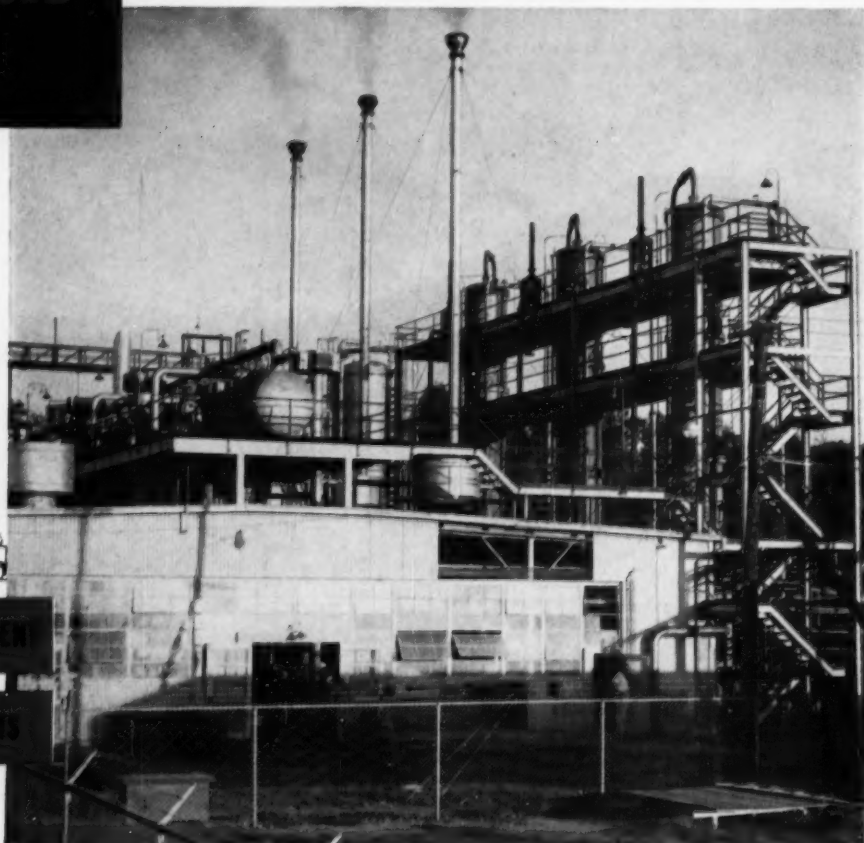
# NITRIC ACID PLANTS

Girdler nitric acid plants employ the well-known Du Pont process, using high-pressure catalytic oxidation, to produce nitric acid. These plants offer greater economy, in both investment and operating costs, than atmospheric or low-pressure units. With the high-pressure process 55%-60% nitric acid is produced with efficient use of catalysts, and with lower utility requirements.



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GAS PROCESSES DIVISION: New York, San Francisco.  
In Canada: Girdler Corporation of Canada Limited, Toronto



DECEMBER 1956

JOHN R. CALLAHAM, EDITOR

### For a Better CE . . .

Next month, when you get your January issue of CE, you'll see a number of improvements.

Many of these will be obvious at once. Others will become evident after you've read a few issues.

Some of these changes are in format, typography and organization. Others—by far the most important—are in subject coverage and contents.

One of the first changes you'll notice is a regrouping of all feature departments. This will make the entire magazine more logical, easier to read and more usable as a reference.

During 1957 we will also strengthen and expand our coverage in several engineering areas.

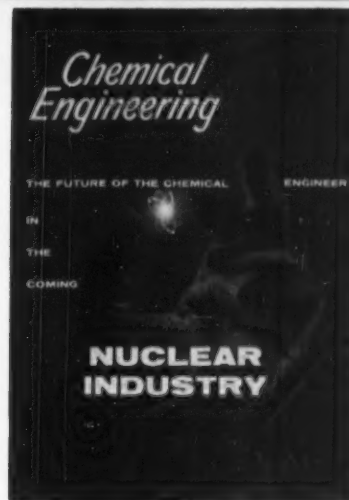
We will carry, for example, more editorial of specific interest to engineers in development and in design work. Our expansion in these areas, in fact, is already well under way.

We have also developed several top-notch article series for early 1957. These will be of major interest to development and design engineers.

One series of 10-12 articles will deal with flow through packed and moving beds. Another evaluates the various methods the chemical engineer uses for approximating physical properties.

Other feature series will deal with process equipment design, physical equilibria and fluid flow formulas.

Next year's CE will be more useful—and more usable—for engineers in all job functions.



## GUIDED TOUR



### What nonmilitary atomic energy will mean to all chemical engineers

Now that nuclear power is a commercial reality, it's time to take stock of our progress. This month's feature report tells who is doing what in the growing nucleonic industry and points up its significance to the chemical process industries and to chemical engineers everywhere. (p. 197)



### A look ahead at high temperatures

Here's some essential information for all chemical engineers—regardless of present responsibilities. It's a look ahead into the future technology of producing and using extremely high temperatures. (p. 173)



### How to buy pressure vessels

For the best engineered pressure vessel, mutual understanding between purchaser





and builder is a "must." Our expert's guidance and new checksheet will help engineers to specify the right equipment. (p. 179)



#### How to clean equipment chemically

Cleaning specialists have a lot of tricks up their sleeves. They may save you money as well as down time. One of today's new techniques could be the answer to your dirtiest problems. (p. 187)



#### Now: titanium for process equipment

Most economical material of construction is titanium—for many applications. Valves, flanges, tubing are available. Price of the light metal is coming down. It's a new star among corrosion fighters. (p. 238)



#### Itemizing a \$2-billion equipment bill

Any number of surveys tell how much the chemical process industries, as a unit, spend on equipment, as a unit. Here's one that tells how much each industry shells out for each type of equipment. (p. 272)



Rejoin **GUIDED TOUR** page 280

# Chemical Engineering

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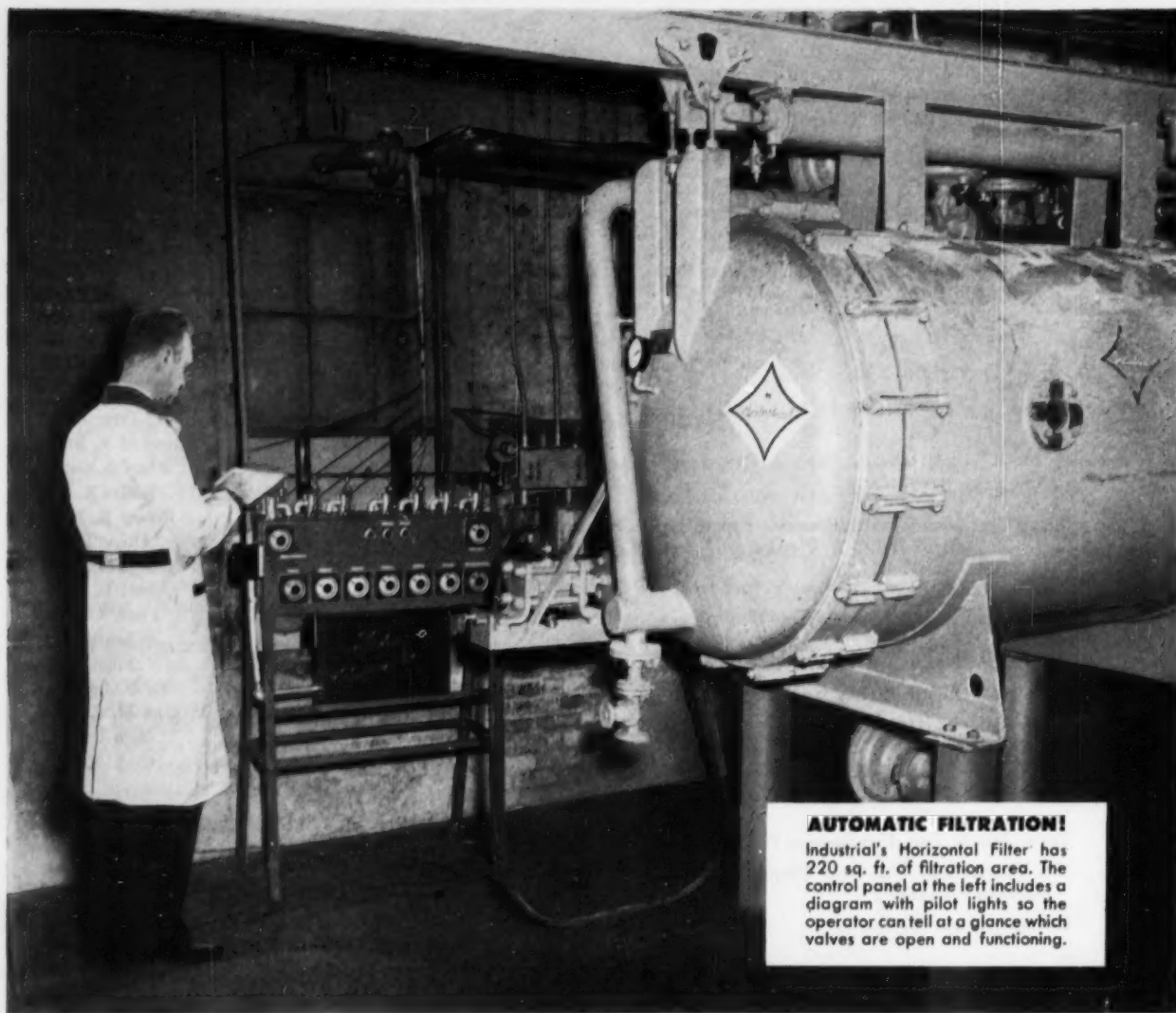
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To keep pace with advances in development, design, production and technical management in the chemical process industries, more engineers subscribe to Chemical Engineering than to any other magazine in the field. Total net paid circulation of this issue:

**42,003**





## ***Different processes...different filters... all by Industrial***

**Wide range of filter types and specific engineering  
delivers efficient filtration for any process.**

### ***Automation tunes filter to peak efficiency at all steps in operating cycle***

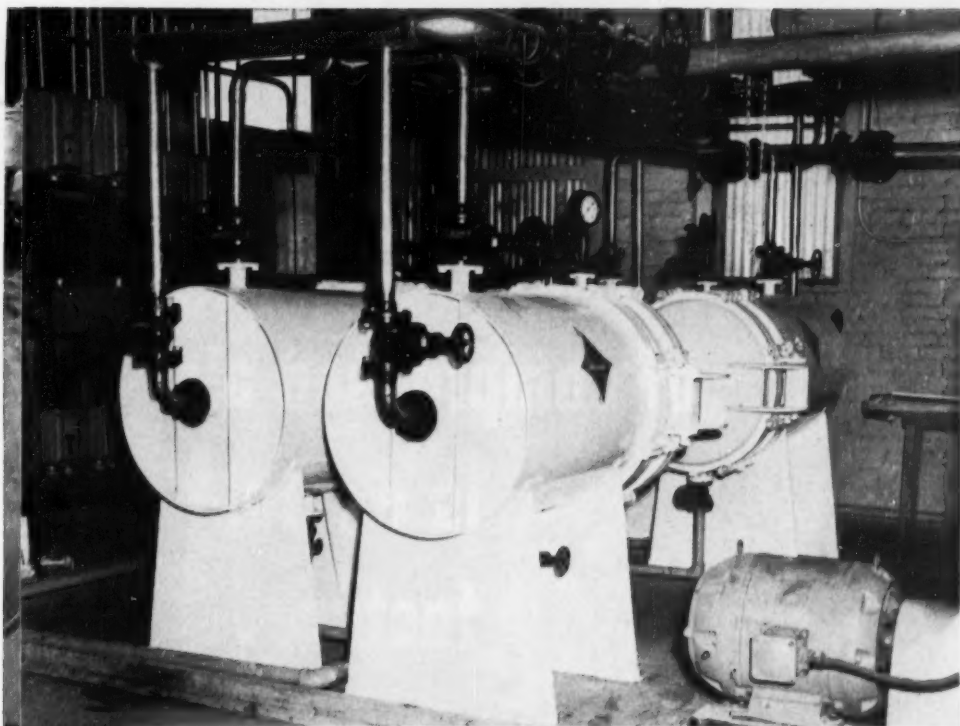
This Industrial filter is engineered to provide unusually complete control in filtering hot "thick" sugar liquor. The automatic controls can be set to carry out a complete cycle during which the filter fills, precoats, filters, drains, fills for shaking with a "thin" juice, shakes the filter cake off the leaves, drains off filter cake, sluices and starts to precoat again.

**Automation** All controls can be preset as desired to time each part of the cycle. The cleaning cycle can be started

either by a timer or by a switch activated by pressure on filter cake. Variations in cycle can be obtained by simply adjusting dials and all automatic controls can be cut out for semi-automatic operation by toggle switches.

**The process** This filter is used to clarify sugar liquor in the second process stage. Here the sugar fluid has already gone thru one filtering operation and has been reduced by evaporation. The fluid is hot (about 150° F) and its viscosity permits a flow rate around 13.5 gallons per square foot per hour or 3000 gallons per hour for the filter. The sugar will go thru several more evaporation and filtering operations before it is ready for use as syrup or made into crystals.





Industrial's Tubular Filters. Each has 72 sq. ft. of filtering area. This type is ideal for polishing and actually costs less than scavenger or auxiliary equipment on larger filters.

## Polishing sugar at 1¢ per 500 lbs.

**Tubular Filters** were recommended by Industrial's engineers for the final clarification of the sugar liquors because they can deliver the desired results at an extremely low cost and are an economical purchase. Operated two at a time, they process 27,000 lbs. in 15 minutes, and from 5 to 11 batches can be processed before cleaning. The low cost is due to the extremely convenient design. Filtrate flows from the inside to the outside of several perforated tubes in the chambers. Filtration is accomplished by filter papers inside the tubes. Cleaning is especially easy, the filter papers are simply taken out and replaced with clean papers.

These sugar plant installations point up the reasons why Industrial is your best choice for any filtration job.

- Industrial provides advanced engineering for specific applications.
- Industrial's standard units bring to your plant the fastest, most convenient and efficient filtration available today.

### SELECTION OF FILTER IS IMPORTANT

Here . . . Industrial offers you a vital service that assures you of the finest filtration system available. Industrial produces all types of filters . . . Horizontal, Vertical Leaf, Tubular, Hydra Shoc . . . and recommends, without partiality, a filter most suitable to your particular requirements. Industrial's accumulated engineering and manufacturing experience can be a great aid to economical processing. Many cost-saving optional features are available and almost all Industrial Filters are adaptable to complete automation. Intelligently selected, soundly engineered filters can pay for themselves in a surprisingly short time.

# INDUSTRIAL

**FILTER & PUMP MFG. COMPANY**  
5918 OGDEN AVENUE • CHICAGO 50, ILL.

CHEMICAL ENGINEERING—December 1956

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Hydra-Shoc  
Bulletin  
No. 114

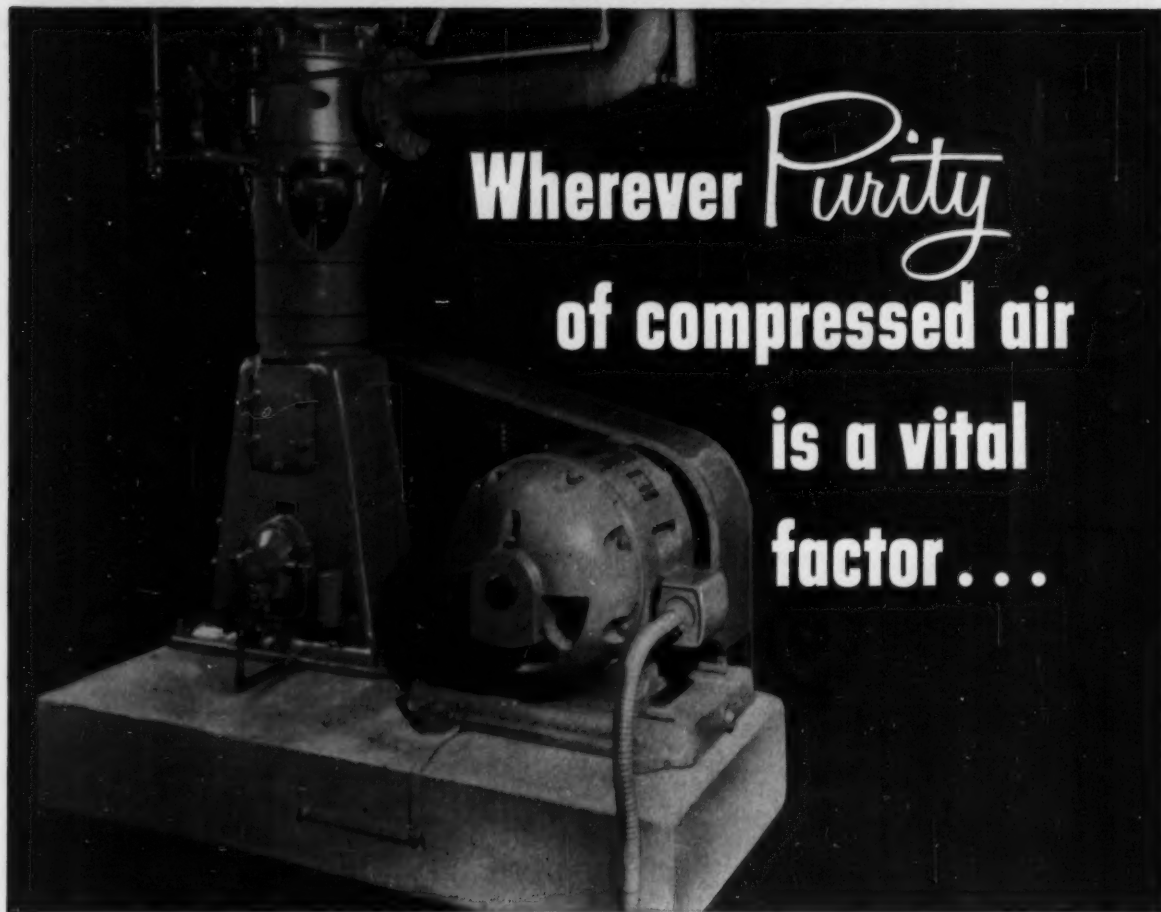
Horizontal  
Bulletin  
No. HH-127

Vertical  
Bulletin  
No. 111

### WRITE FOR DETAILS

Reprints of "Automation," an article from Sugar Magazine about a typical sugar installation, are available as well as folders describing all Industrial Filters, Vertical, Horizontal, Tubular and Hydra-Shoc.





Wherever *Purity*  
of compressed air  
is a vital  
factor...

## JOY "WG-9" OIL-FREE COMPRESSOR

Joy WG-9 oil-free compressors are equipped with carbon graphite piston rings. These need no lubrication, and compensate automatically for wear. Special lightweight pistons; large, direct air passages; and liberal water-jacketing reduce heat and minimize ring wear.

Patented Dual Cushion valves are made of corrosion-resistant materials. All wearing areas except the rings, are either chrome-plated, surface-hardened, or made of stainless steel.

The Joy WG-9 is a double-acting, water-cooled compressor designed for *continuous*

service. It is full force-feed lubricated and features replaceable-on-the-job cylinder and crosshead liners. Capacity is to 881 CFM, 125 psi. This unit is available also as a lubricated machine for standard air needs or for vacuum pump service.

Joy builds regular and oil-free compressors to meet any capacity and pressure requirement. For complete details, write to *Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.* In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 104-11

*Consult a Joy Engineer*

for VANEAXIAL FANS • COMPRESSORS • OXYGEN GENERATORS  
VACUUM PUMPS AND BOOSTERS

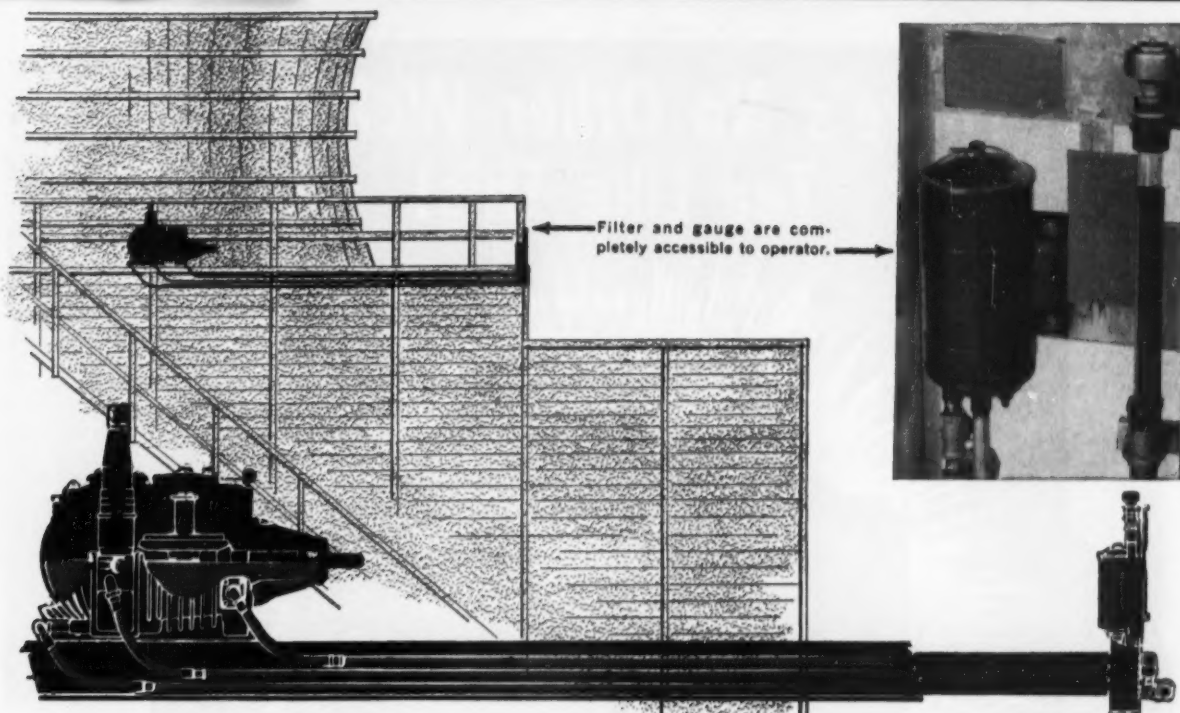


NEW 10100-104

# JOY

SPECIALISTS IN THE COMPRESSION AND  
MOVEMENT OF AIR AND GASES SINCE 1885





# Engineered Lubrication PAT. PENDING for **COOLING TOWER POWER**

**Another important Marley first**

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Marley Engineered Lubrication provides a complete change of clean oil up to ten times during every hour of operation. By constantly circulating the oil through a renewable cartridge filter all particles of foreign matter, sludge and emulsion are removed, not once every six months but minute by minute. With Marley Engineered Lubrication, clean oil stays clean; it is not subject

to progressive contamination from the moment it is put in service.

Engineered Lubrication gives the operator safe, logical, full-time control. With both filter and sight-gauge mounted outside the fan cylinder and always in view he takes nothing for granted. He knows the oil level in every Geareducer at all times. He can obtain oil samples for testing without shutting down the fan.

Engineered Lubrication is an epochal advancement in cooling tower service and operating economy. The Marley engineer in your nearest major city awaits an opportunity to show you how it functions without wear on any parts of the centrifugal-type flow system, without added power, without effort. Call him or write



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**The Marley Company**

Kansas City, Missouri



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STAINLESS STEEL, MONEL, NICKEL and ALUMINUM WELDING FITTINGS  
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The Welding Fittings organization — recognizing the superiority of welded piping for corrosion service — was the first to standardize, manufacture, and stock a complete line of stainless steel welding fittings.

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NEW CASTLE, PENNSYLVANIA

W-10

World's Largest Manufacturer of Stainless Welding Fittings

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- Ends machine tool cut and finished.
- Annealed, cleaned bright, passivated.
- Heat number permanently stamped on each tee as record of actual analysis and physical properties.
- Every tee is marked with type of metal, size, schedule, wall thickness, and FLOWLINE trade mark.



*Even When You Face . . .*

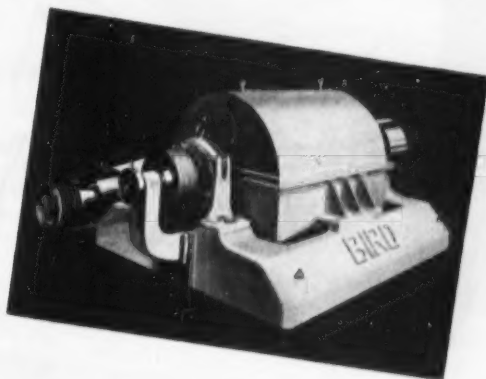
**FILTER  
FEEDS  
VARYING IN  
VOLUME**

**FILTER  
FEEDS  
VARYING IN  
SOLIDS  
CONTENT**

**FILTER  
FEEDS  
VARYING IN  
TEMPERATURE**

**FILTRATION** *doesn't need to mean* **FRUSTRATION**

*just feed 'em to a*  
**BIRD CONTINUOUS  
CENTRIFUGAL FILTER**



The fact is you can feed the Bird most anything in any measure.

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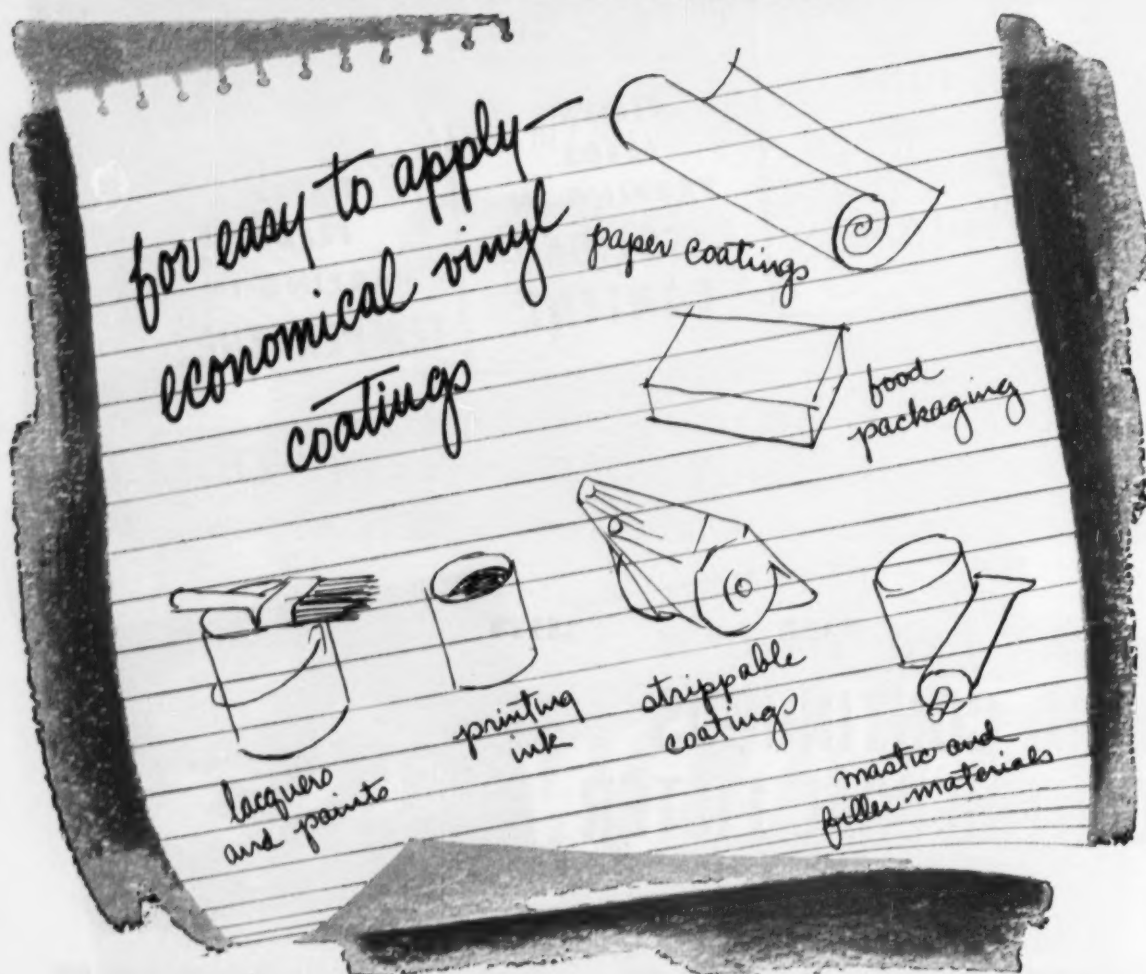
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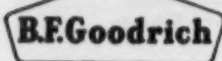
### GET THE FACTS

A new booklet "Geon Solution

Resins" contains complete technical data and application information. For your free copy write Dept. DB-12, B. F. Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

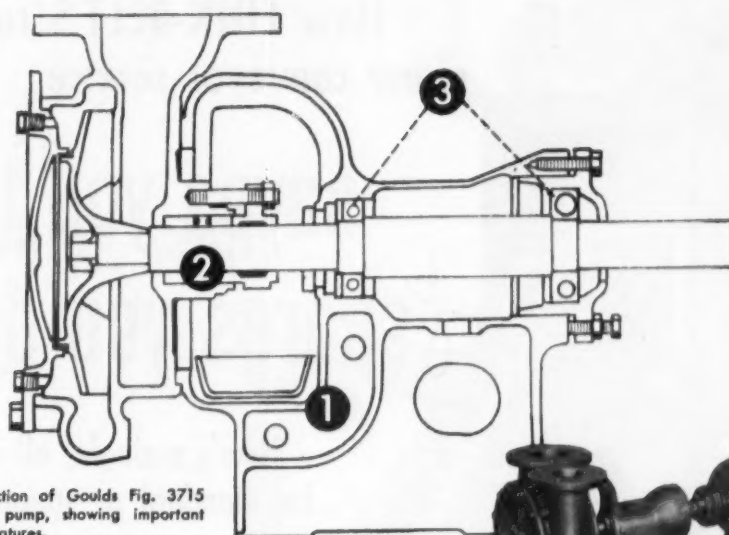


**B.F. Goodrich Chemical Company**  
a division of The B.F. Goodrich Company

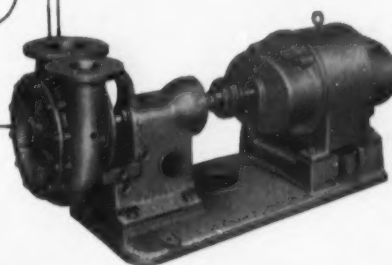


GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors





Cross section of Goulds Fig. 3715 chemical pump, showing important design features.



## You can put the heat on this chemical pump

Handling hot, corrosive, or abrasive liquids is what the Goulds Fig. 3715 pump is built for.

You can run this pump at 350° F. by cooling the support head (1) and quenching the gland, through fittings that are built in.

And you can get the pump in a variety of materials to meet your particular liquid-handling needs—type 316 stainless steel, Gould-A-Loy 20 (equivalent to ACI CN 7M CU), all bronze, bronze-fitted, all iron, or iron or bronze with stainless trim. These materials regularly stocked—other material can be furnished on order.

### Wide range of sizes

There's a size, too, to meet most requirements—nine sizes in all, providing capacities up to 720 GPM, and heads to 200 ft.

Whatever size and construction material you need, you can be sure that your Goulds Fig. 3715 pump will operate with high efficiency and low maintenance cost.

### Mechanical seals available

The stuffing box (2) is on the suction

side of the impeller, subject to suction pressure only. Or we can equip your pump with either a single or double mechanical seal. Completely sealed bearings (3) keep out dirt and moisture, and are grease lubricated.

You can inspect and clean the interior of the pump, or remove and replace the impeller, without disturbing piping connections. You can adjust axial clearance between the impeller vanes and the casing by external means.

### Interchangeability of parts

And you can keep your parts inventory low, for many of the parts are standardized for interchangeability between sizes. For example, you need only two different shafts for all 9 sizes of Fig. 3715 pumps.

We'd like to send you additional details about these chemical pumps. Just drop us a line, asking for Bulletin 725.4. It gives performance curves, sizes and specifications. Or, if you have a pumping problem of any kind one of our representatives will be glad to consult with you about it.



Goulds stainless steel pump handling corn meal mush in a food plant.



This Goulds chemical pump is handling hot fatty acids in an oil processing plant.



These three Goulds chemical pumps circulate hot size in a textile plant.



ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA • PITTSBURGH • TULSA

CHEMICAL ENGINEERING—December 1956





How LINK-BELT'S complete  
screw conveyor service

saves you time  
spares you details

Here's a single, all-inclusive source  
for standard or special requirements

This four-point program provides quick and easy answers to any screw conveyor problem. Link-Belt offers you the widest range of component types and sizes.

For example, you choose from 17 basic screw designs—in any suitable metal to meet temperature, corrosion, sanitation, abrasion and other requirements . . . in a full range of diameters, gauges and pitches. Whatever you need in components . . . and to whatever extent you require engineering counsel—Link-Belt will devise a system "tailored" to your specific needs. Ask your nearby Link-Belt office or authorized stock-carrying distributor for 92-page Data Book 2289.

◀ **SCREW CONVEYORS** are readily adaptable to inclined (left), horizontal or vertical handling of bulk materials.

1 **ANALYSIS AND ENGINEERING** service is provided by a district sales office in your area. Link-Belt district engineers can quickly ascertain the best conveying arrangement for your specific application.

2 **COMPLETE LINE OF SCREW CONVEYOR COMPONENTS** and related elevating, conveying and power transmission equipment is your assurance that specific needs will be fulfilled most efficiently and economically.

3 **EASY ERECTION** is achieved because of prefabricating, match marking, close-tolerance manufacturing and layout drawings. Link-Belt will handle entire erection assignment if you wish.

4 **SATISFACTORY PERFORMANCE** is assured when you rely on Link-Belt as a single-contract source for your complete system. We will accept full responsibility for placing it in operating readiness for you.

**LINK-BELT**

**SCREW CONVEYOR EQUIPMENT**

**LINK-BELT COMPANY:** Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

14,289

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INTEGRATED COMPONENTS INCLUDES:**



SCREWS



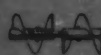
HANDERS



TROUGHS



SPOUTS & GATES



SHAFTS &  
COUPLINGS



TROUGH ENDS



DRIVES



as easy as  
stacking coins



### Hackney chemical containers stack four-high ...save shipping, handling and storage costs

Here's the lightweight, stainless steel acid container that builds a safe, compact stack—saves warehouse space and handling time for you. Bottom foot ring of the 15½-gallon Hackney chemical container fits snugly over top ring of lower barrel.

Designed with easy-to-grasp, full curled foot rings for safe, one-man handling and convenient pouring. Your name can be embossed on the bottom ring. Low tare weight reduces transportation costs. Stainless steel protects your dangerous or corrosive chemical products—eliminates breakage losses.

These 15½-gallon containers are just one of the many types and sizes of returnable shipping containers that bear the famous Hackney name. Write today for the complete Hackney Drum and Barrel Catalog.

## Pressed Steel Tank Company

Manufacturer of Hackney Products

1447 South 66th Street, Milwaukee 14, Wisconsin • District Offices:

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Downtown Iron Works, Inc., Division, 140 Wallace Ave., Downingtown, Pennsylvania • 105 Riverside Circle, Marshfield, Mass. • 4247 North Avenue, No. 10, Cincinnati 36, Ohio • 57 E. Wentworth Ct., Room 105, Minneapolis 19, Minn.



**CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS**



# 5 Industries ... Well-Known Companies

... typical of more than  
100 companies for whom Grinnell  
is currently fabricating

## POWER AND PROCESS PIPING

### CHEMICALS

NATIONAL ANILINE DIVISION OF  
ALLIED CHEMICAL & DYE CORP.,  
Hopewell, Va.

### PULP & PAPER

UNION BAG & PAPER CORP.,  
Savannah, Ga.

### POWER

PENNSYLVANIA POWER  
& LIGHT COMPANY,  
Allentown, Pa.

### BEVERAGE

CARLING BREWING COMPANY,  
Natick, Mass.

### OIL REFINING

TIDEWATER OIL COMPANY,  
Delaware City, Del.

These successful companies, leaders in their respective fields, are building new facilities right now. The power and process piping needed in this construction is being fabricated in Grinnell shops.

In fact, at this time — or at any given time, more than one hundred similar-type orders for prefabricated piping are being worked on by Grinnell. Why this marked preference by so many companies for Grinnell?

Because piping fabricated in Grinnell shops is done under ideal conditions, with modern equip-

ment, by personnel qualified for each class of work. Included in the price (which is determined in advance) are such items of expense as: interpretive engineering, shop sketches and planning, procurement of materials, power services, expendable tools and supplies. All piping is rigidly inspected and tested to comply exactly with customer specifications and applicable codes. Consult Grinnell on your next piping job.

## GRINNELL

WHENEVER PIPING IS INVOLVED

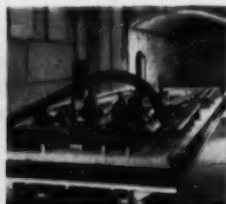
**ATTENTION:** A 30-minute color sound film showing the quality and economy of Grinnell Shop Fabrication of all classes of piping is available for group showings.



Pipe being heated to exact temperature required for proper bending



Skilled team completes bend in six minutes with pipe close to 2000°F



Fabricated piping, bending operation completed, enters stress-relieving furnace



Heavy wall pipe being machined to the proper welding bevel on a post mill



Ultrasonic testing of a weld on heavy wall pipe



Grinnell Company, Inc., Providence, Rhode Island

Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves  
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies  
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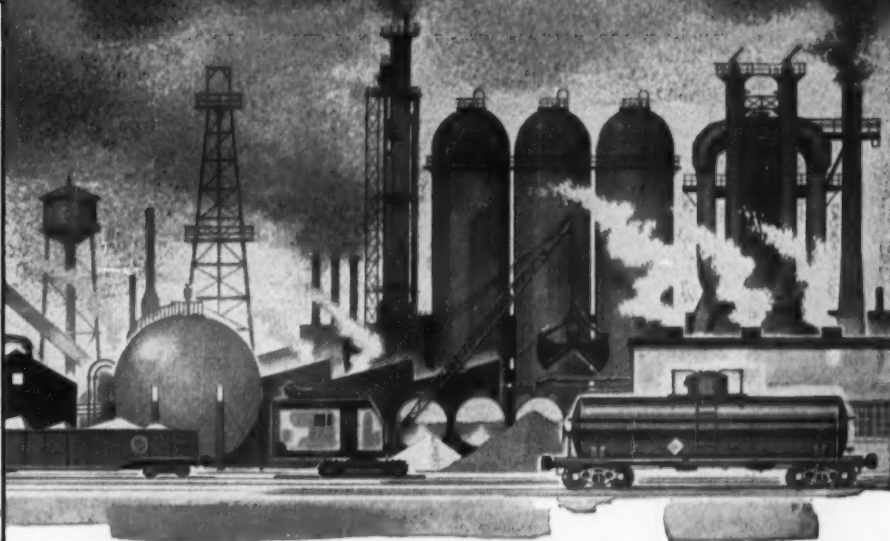
# IS YOUR INDUSTRY LISTED HERE?

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Cement and Concrete  
Cosmetic  
Disinfectants  
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Electroplating  
Enamel  
Engraving and  
Electrotyping  
Feed Stuff, Mineral Feed  
Fertilizer  
Food  
Glass  
Insecticide and Fungicide  
Laundry  
Leather  
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Covering  
Lubricant  
Match  
Metallurgical  
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Oil Cloth  
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Paint, Varnish and Lacquer  
Paper  
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Pharmaceutical  
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Pottery  
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**FREE!** This 16-page booklet lists the many chemicals available from Harshaw.



**WRITE TODAY FOR YOUR COPY**



## HARSHAW CAN SERVE YOU!

**Harshaw sells chemicals — thousands of them — for these and many other industries**

**Here are typical Harshaw chemical products**

Electroplating Salts, Anodes and Processes

Organic and Inorganic Dry Colors and Dispersions

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# little sam

## OPW-JORDAN packless, self closing, sliding gate SAMPLING VALVE

for hazardous and corrosive liquids

HOT SOLVENTS  
HOT CAUSTICS  
INFLAMMABLE LIQUIDS

- **INSTANTANEOUS SELF CLOSURE** . . . Release of handle automatically closes sliding gate for a positive shut-off. No overflow.
- **LEAKPROOF** . . . Self-lapping and self-cleaning micro lapped seat assures safe, positive no-leak closure with a minimum of 5 psi inlet pressure.
- **PACKLESS** . . . Metallic diaphragm eliminates leakage and friction at stem. Will not stick when in open or closed position. No packing or composition gaskets to deteriorate, service, or replace.
- **EASY-GRIP FLOW CONTROL** . . . Selective, non-splash, grip-regulated flow. Hand pressure on grip handle regulates flow of sample from a mere drop to full even flow.

The OPW-JORDAN No. 90 Sampling Valve is an outstanding valve, painstakingly engineered for the specific purpose of drawing off hazardous and volatile liquid samples for laboratory test or examination. Easy to operate, the No. 90 provides a convenient, accurate means of sampling liquids without danger to personnel, loss of product or damage to equipment. Durably constructed for hard continuous usage, the basic design and exclusive features of this valve insure its outlasting and out-performing ordinary sampling valves.



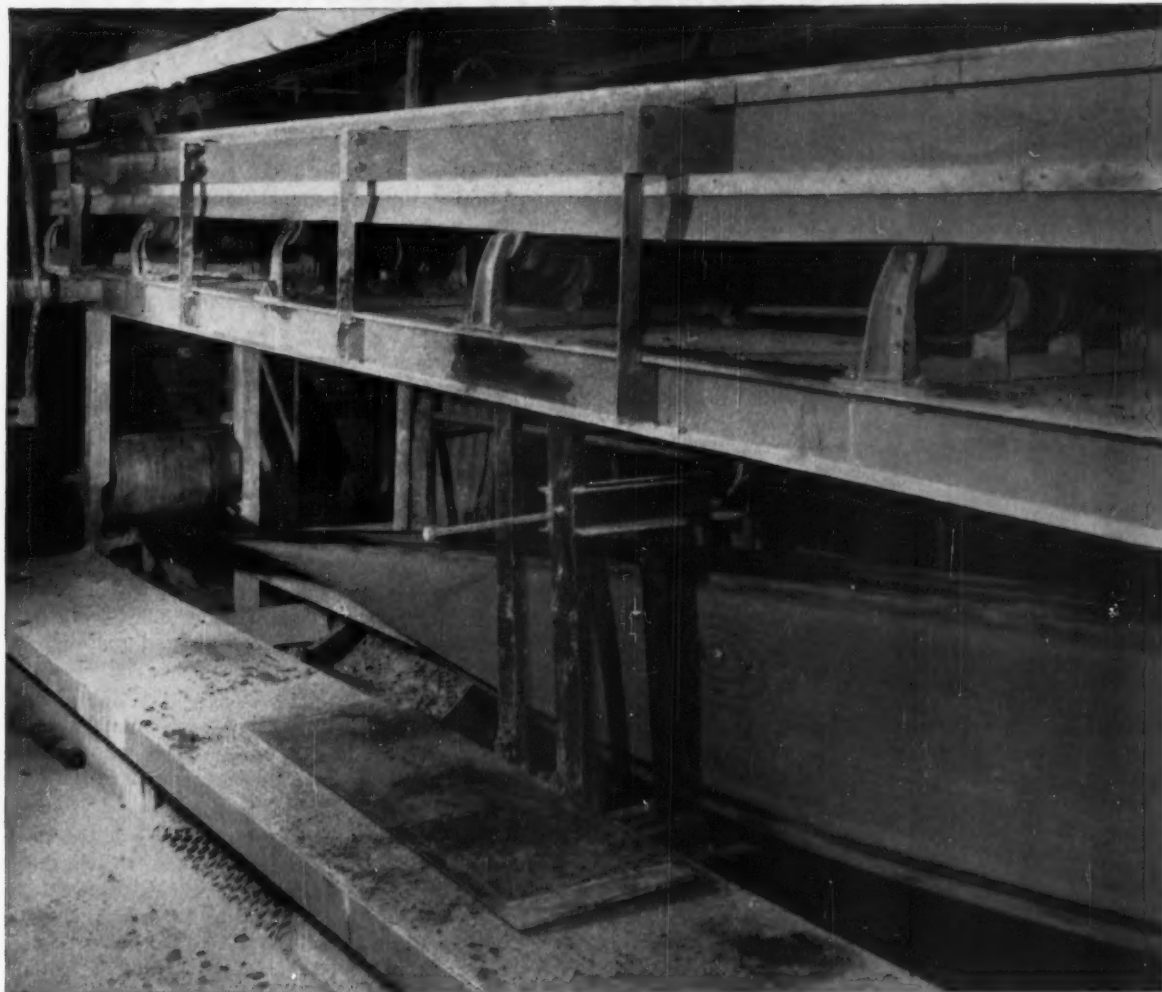
### JORDAN CORPORATION

DIVISION OF OPW CORPORATION

6013 Wiehe Road Cincinnati 13, Ohio Elmhurst 1-1352



# B.F. Goodrich



## How to handle sticky chemicals without damage to conveyor

**T**HAT belt carries triple superphosphate, a hot, sticky, abrasive chemical that's made into fertilizer. Handling the stuff with a regular conveyor used to be a terrific problem. Sticky particles would cling to the belt, build up into gummy layers, clog the return idlers, damaging the belt cover.

Then a B. F. Goodrich distributor recommended something quite different in conveyors—the B. F. Goodrich "turnover" belt system. Here's how it works. As the material is dumped off the end of the moving belt, the belt makes a 180° turn, (as shown in the picture), runs empty along the return

idlers, then makes another one-half turn before receiving the next load.

Only the clean side of the belt touches the idlers, so there's no chance for sticky materials to build up on them. Danger of belt damage is reduced because lumps of materials cannot be trapped between the belt and pulleys. At the chemical company shown in the picture, engineers predict they'll get three times more service from the belt on the "turnover" system.

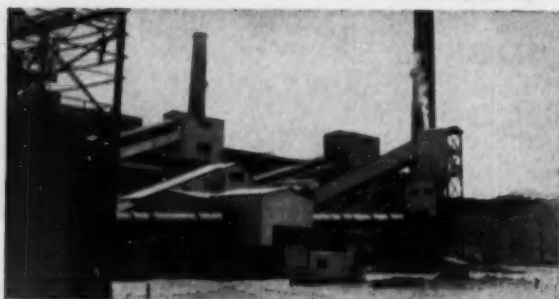
If you have an operation where sticky, corrosive materials must be moved from place to place, the B. F. Goodrich "turnover" conveyor system may be

the answer. Let a B. F. Goodrich distributor give you full details and show you how easy it is to convert a conventional conveyor into the turnover type. B. F. Goodrich Industrial Products Company, Dept. M-813, Akron 18, Ohio.





# IMPROVING QUALITY... REDUCING COSTS FOR LEADING CHEMICAL PROCESSORS



Throughout the chemical industry... wherever you find a sizeable thermo-processing operation... you'll find a Traylor Rotary Kiln on the job protecting product quality, reducing maintenance bills and lowering production costs.

Traylor's half-century of engineering experience has produced many major improvements that have become accepted standards for modern kiln design. Cast steel or forged steel riding rings, of the full-floating type are specially mounted to hold them securely in place relative to the easily adjustable single roller supports. The roller supports are of heavy integral design and can be adjusted as a unit. The shells are extra heavy with ample reinforcing bars. Thus, Traylor Kilns achieve exceptional thermo-processing and maintenance economies.

The success of Traylor Rotary Kiln design is best emphasized by the large number of leaders in the processing industries who have returned time after time to purchase additional Traylor Kilns.

Traylor has custom built Rotary Kilns in sizes to 12' in diameter and 450' in length. For full specifications on a kiln to best suit your specific product, write for a free copy of illustrated bulletin 1115 outlining the features of Traylor Rotary Kilns, Coolers and Dryers.



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Stainless steel equipment  
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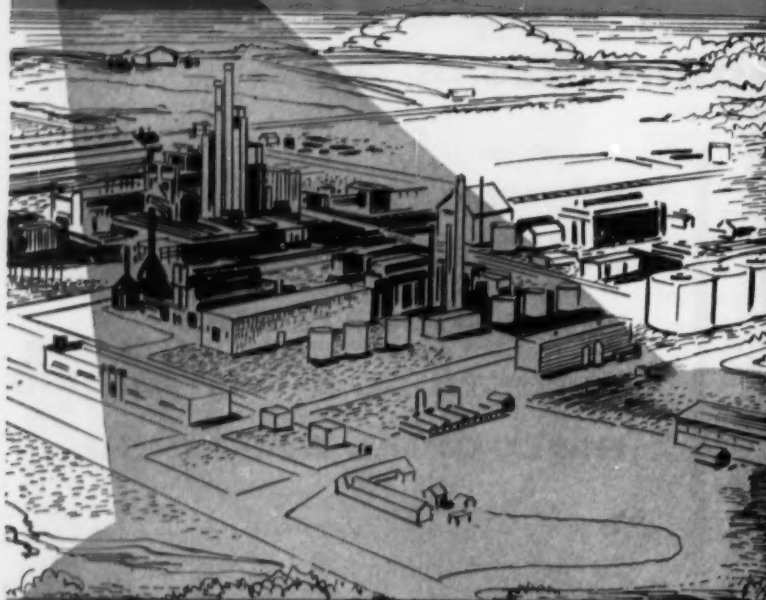
# A STEAM TRAP CASTS A



**BIG** effects from little traps! And, the effects are multiplied by the number of traps in the plant you design or operate until they grow to be a *major influence* upon operating efficiency and economy. Before you specify steam traps ask your nearby Armstrong Representative to call. He is qualified to give you practical assistance and answers that can save you a lot of time and trouble.

## THINGS STEAM TRAPS AFFECT

1. HEAT-UP OR START-UP TIME
2. RATE OF PRODUCTION
3. STEAM WASTE
4. FUEL WASTE
5. CONTINUITY OF OPERATION
6. MAINTENANCE COST



Cast semi-steel side inlet—side outlet series.  $\frac{1}{2}$ ",  $\frac{3}{4}$ ", 1", and  $1\frac{1}{4}$ " pipe connections.

Cast semi-steel bottom inlet—top outlet series.  $\frac{1}{2}$ ", through 2" pipe connections.

Forged steel series for high pressures to 1500 psig and for low and medium pressures where all-steel fittings are desirable.



**ARMSTRONG  
MACHINE WORKS**

858 Maple Street  
Three Rivers • Michigan



# MIGHTY BIG SHADOW

REASON	HOW ARMSTRONG TRAPS MEET THE NEED	EXAMPLE
When steam is turned on, large amounts of condensate and air must be removed before equipment heats up.	Condensate and air removed as fast as they reach trap. Reliable data insures you get trap with adequate safety factor to meet conditions.	<u>40 Minute Faster Heat-up</u> —drying oven at pharmaceutical plant heats up 40 minutes sooner with Armstrong "Blast" traps.
Quick heat-up, maximum temperatures essential for maximum output.	Air which reduces temperature and heat transfer discharged automatically; condensate discharged at steam temperature; equipment kept full of hot, dry steam.	<u>30% Greater Output</u> —jacketed kettles produce 30% more at Canadian plant since changing to Armstrong traps.
When steam gets past traps, boiler capacity may be inadequate—this is bad even if you could afford the fuel waste.	When steam floats the bucket the trap closes. No steam ever reaches discharge orifice, even when there is no condensate load. Heat treated chrome steel valve parts, precision ground and lapped, resist wire drawing and wear, stay leak tight for a long, long time.	<u>Steam Savings Eliminate Need for New Boiler</u> —chemical plant shelves plans to buy larger boiler after installing Armstrong Traps.
Why burn fuel to generate steam that does no useful work . . . blows through traps, for example?		<u>33½% Reduction in Fuel Bill</u> —after trapping vats with Armstrongs at Missouri plant.
When traps are inoperative or down for repairs, unit being drained may be "off the line."	Nothing to clog, seize, stick or collapse! Large orifice. Self-scrubbing action cleans out ordinary dirt and scale. "Frictionless" leverage with wear points heavily reinforced for long life. Hardened chrome steel valve and seat. Wear and corrosion-resistant stainless trim.	<u>Maintenance Time Cut 30%</u> —Illinois user says, "Unequalled dependability, simplicity of design means repairs can be made quickly" (with minimum equipment downtime).
Traps that don't "wear well" take a lot of manhours for repair.		<u>50% Less Trap Maintenance</u> —only half as many manhours devoted to traps since installing Armstrongs throughout large Midwestern plant.

## SEND FOR THE ARMSTRONG STEAM TRAP BOOK

**CATALOG J**—44 pages of practical trapping data. Tells how to select traps for nearly every class of equipment; explains safety factors; gives prices, physical data, service pressure ratings of Armstrong traps; includes recommended installation, maintenance and trouble-

shooting practice; contains many time-saving charts and tables—condensing rates, trap capacities, trap size recommendations and others. For your free copy, call your local Armstrong Representative or write to Armstrong.

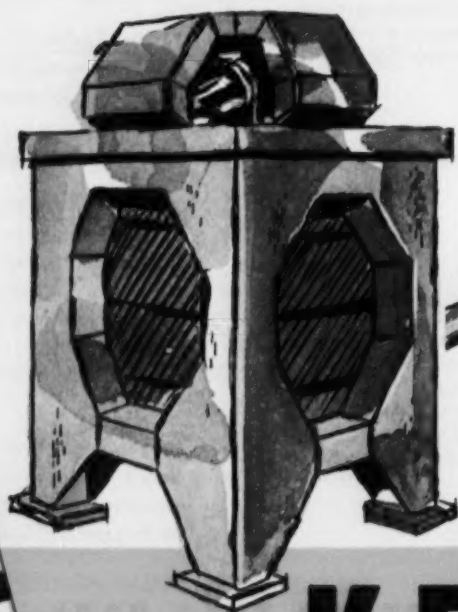




# Check these the KENNEDY Pneumatic

- ✓ NO motors, screws or high speed moving parts.
- ✓ EXCLUSIVE BATCH CYCLE by weight can be used to check inventory.
- ✓ UTILIZES HIGHER PRESSURES for greater efficiency . . . smaller diameter pipelines can be used.
- ✓ ONE PUMP handles more than one material through same pipeline without contamination.
- ✓ Compressed air used only when transporting material at full capacity.
- ✓ Complex Distribution problems automatically solved by the system's unique features.

For more than a quarter-century, Kennedy-Van Saun has designed and manufactured Pneumatic Transport Pumps and complete pneumatic transport systems. Many of America's largest industrial concerns look to KVS for the solution of their materials conveying problems. We have the equipment and the "know how" to apply it to **your** particular problem. Let us show you how the KVS System can provide the most economical installation for **your** plant.



**KENNEDY AIR ACTIVATED CONTAINERS** — Shipping containers that unload pneumatically! Used on trucks, barges and many railroads—send for details.



SEND FOR LITERATURE

# KENNEDY

MANUFACTURING & ENGINEERING CORPORATION



# advantages of Conveying System



## TYPICAL MATERIALS HANDLED

### CARBON BLACK

America's largest Rubber producers use Kennedy Automatic Pneumatic Systems for cleaner, more efficient plants.

### HYDRATED LIME

Ideal for pneumatic handling, Kennedy Pumps are used by lime producers as well as by consumers.

### SODA ASH

Unloaded from cars or transported within plants over great distances in basic chemicals and aluminum industries.

### DOLOMITE

A new development in the Steel Industry!—Patching open hearth furnaces with a Kennedy Pneumatic System.

### LUMP LIME

The nation's largest producers of lime transport lump lime up to 3½" in size.

### PETROLEUM COKE

In the aluminum industry producers rely on the Kennedy Pneumatic System in their reduction plants.

### ASPIRIN CRYSTAL

Special corrosion-proof equipment pneumatically transports this difficult-to-handle material in the pharmaceutical industry.

### BARIUM SULPHATE

As readily handled within a plant with a Kennedy Pneumatic Pump as in the oil fields.

### SODIUM BICARBONATE

Conveying of sodium bicarbonate at large pharmaceutical plants done with the Kennedy system.

### ANTHRACITE COAL

In large power stations where dependability is paramount Kennedy Pneumatic Systems are used.

### CEMENT

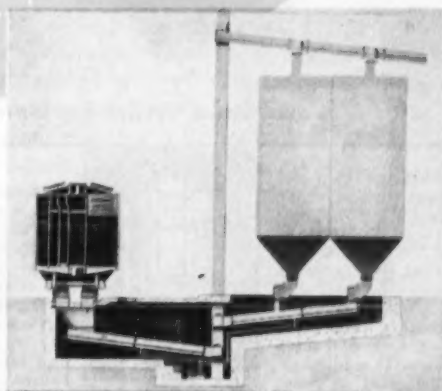
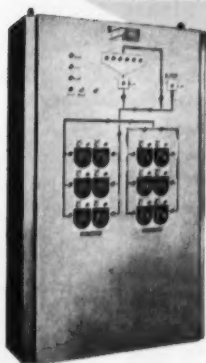
Transported with Kennedy Pneumatic Systems of all sizes in cement mills and concrete plants.

... AND MANY OTHERS

## INSTALLATIONS THROUGHOUT THE WORLD ...

**KENNEDY PNEUMATIC CONVEYING SYSTEMS**—Complete with automatic controls, designed, manufactured and erected by KVS for unit responsibility and guaranteed performance.

**KENNEDY AIR CONVEYORS**—Gravity-aeration conveyors famous for low power requirements, minimum headroom and freedom from maintenance.



# - VAN SAUN

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# Here's the Answer...

## To trouble-free pressure vessel mixing

Philadelphia "packaged" Mixers are designed for maximum adaptability to all fluid agitation applications. Standardization, high-production and complete control of all manufacturing by Phillie Gear assures you outstanding mixer performance at minimum cost.

### *Check these unmatched features:*

**1** Mechanical seal readily accessible... just loosen coupling bolts... entire shaft and impeller assembly is then independently supported... *no lifting equipment required* for replacement of seals.

**2** Lower shaft bearing placed close to seal for minimum runout... separated sufficiently to prevent interleakage of lubricants.

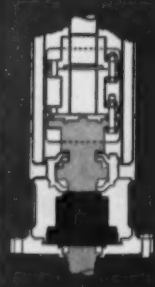
**3** In-tank coupling optional... provided if desired for easier unit installation... not necessary where process conditions limit its use.

**4** Seal will operate for years without maintenance... is designed for quick replacement as a single unit... retention of factory-established shaft alignment is assured.

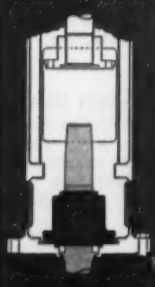
For complete information, please request Bulletin A-256.

**One man and a wrench can remove and replace this new Unitary shaft seal in minutes.**

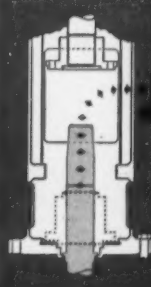
(1) Loosen lock ring at top of seal. MIXER SHAFT IS NOW FREE TO MOVE UP OR DOWN THROUGH SEAL. Next, loosen extra long bolts in lower flange of spacer coupling. Shaft drops until collar rests in cup on mixer base flange. The entire weight of lower shaft and impellers is supported by this assembly.



(2) Remove bolts and pull out spacer, thrust plate and half coupling from top of mixer shaft. Unbolt and remove top of lower bearing housing. Loosen bearing lock nut, remove bearing components and lower half of housing. Note that absolutely no lifting equipment is needed.



Remove mechanical seal assembly by simply sliding it up mixer shaft and out through opening in reducer support stand. Replace with a spare seal assembly and ship the old seal to us for maintenance.



## philadelphia mixers

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# Here's the Seal...

that makes Philadelphia Mixers so trouble-free



*For further information on this particular mechanical seal, contact Philadelphia Gear Works. For your other mechanical seal problems call your Garlock representative at any of Garlock's 30 sales offices and warehouses throughout the U.S. and Canada.*

Engineers at Philadelphia Gear Works asked Garlock to design a seal that would operate for years without replacement . . . a seal that would make it possible to run *any* chemical, pharmaceutical, or food processing operation under pressure without contamination.

These specifications called for a precision-made mechanical seal which could outperform even the best designed stuffing box.

*Here is the seal Garlock designed for Phillie Gear:*

1. The "Philadelphia-Garlock" Seal is completely self-contained. Factory pre-set . . . no on-the-job adjustments needed. Just slip over agitator shaft, bolt to mounting flange and tighten lock ring to shaft . . . makes both installation and replacement easier than with *any other design*.

2. Standard Seal Assemblies, available from stock, are constructed with all metal components in contact with process liquids made of type 316 stainless steel, all resilient members of Teflon. It is the most versatile *standard* seal available. It can be used with acids, alkalis, most solvents, and under practically all process conditions. The standard seal is rated for temperatures up to 450° F., pressures to 200 p.s.i.g.; other seals available for pressures to 1000 p.s.i.g.

THE GARLOCK PACKING COMPANY, Palmyra, New York

## GARLOCK

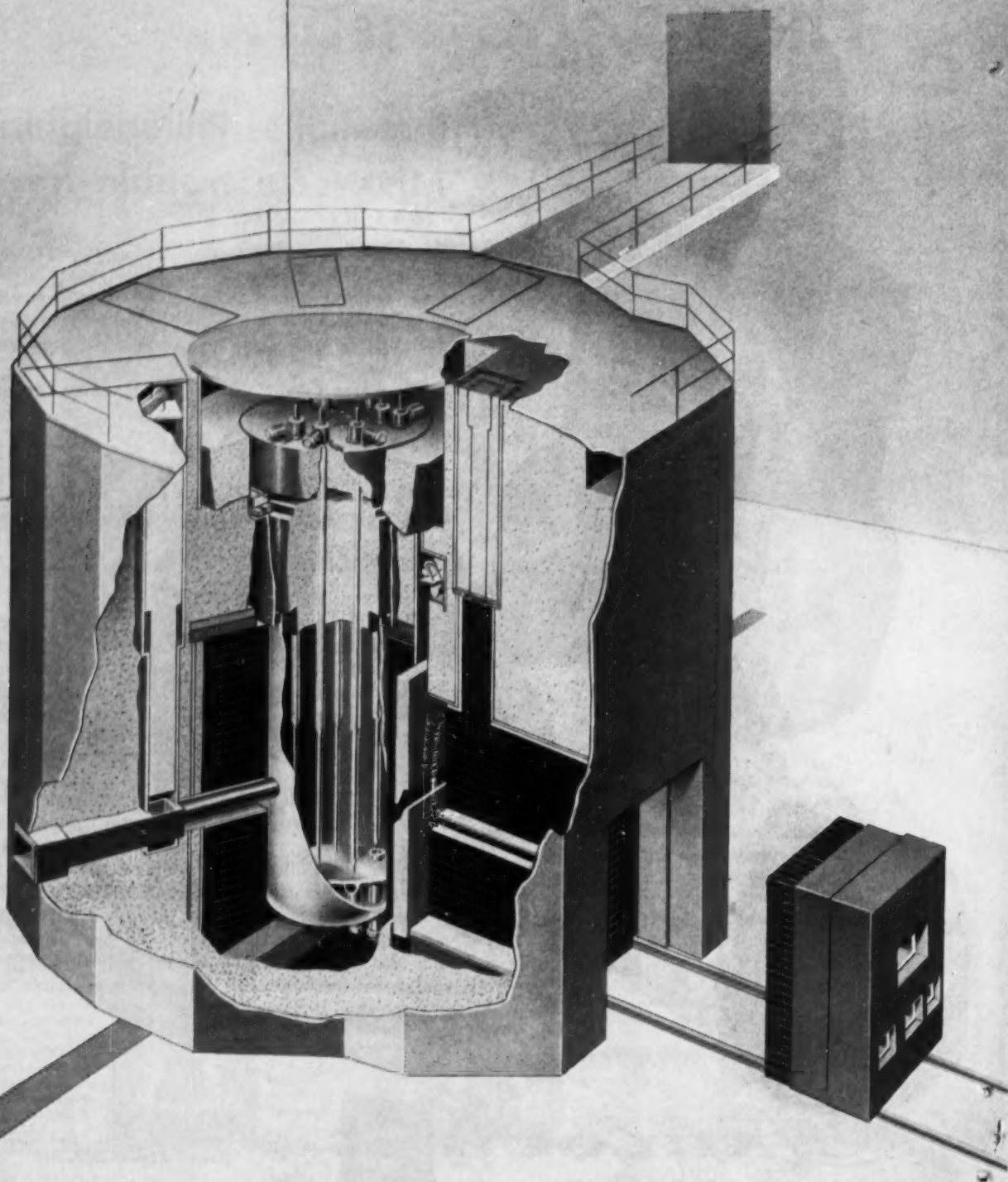


*Packings, Gaskets, Oil Seals, Mechanical Seals,  
Rubber Expansion Joints*





## NUCLEAR RESEARCH REACTORS



**HEAVY-WATER REACTOR** has a maximum thermal-neutron intensity of  $2 \times 10^{14}$  neutrons/cm<sup>2</sup>/sec. when operating at 5000-kw heat removal rate. Fuel inventory for this reactor is 2200 grams of enriched U-235.



# General Electric Now Offers Three Nuclear Research Reactors

Any one of General Electric's three basic research reactors can be modified to meet your particular research requirements.

**HEAVY-WATER REACTOR** is cooled and moderated with heavy water. The high neutron flux density and wide choice of test facilities make this reactor ideal for research institutes with concurrent experimental programs. The basic reactor can be provided with a number of experimental facility combinations due to the large volume of test space available.

**SWIMMING-POOL REACTOR**, moderated and cooled by ordinary water, has exceptional flexibility and high neutron flux. Bulk shielding, biological tests and general radiation experiments are among the experimental activities which may be carried out in the Swimming-pool Reactor. This reactor is particularly suited to industrial and educational uses.

**NUCLEAR TEST REACTOR**, water cooled and graphite moderated, is a compact and flexible research tool designed for nuclear investigations with thermal neutrons. Its small size, and excellent control features make it an extremely precise device for industrial process or educational use. This reactor can be operated at low power (no shielding necessary up to

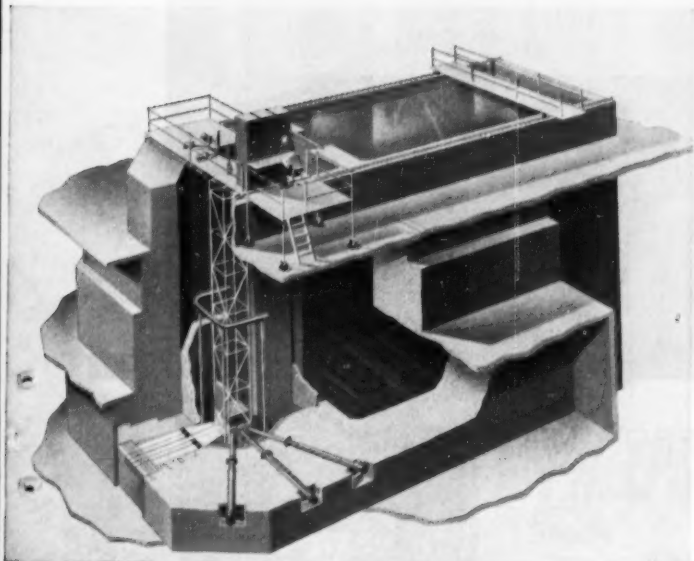
100 watts) with provision for adaptation to high power operation. Minimum auxiliary and building requirements and ease of installation are added NTR features.

**G-E SEVEN-POINT PROGRAM** can help you obtain any of these reactors. Under this program, General Electric's Atomic Power Equipment Department, San Jose, California, will provide: (1) Reactor specifications, (2) Building study coordination, (3) Assistance in preparation of hazard summary report, (4) Manufacture of reactor and associated equipment, (5) Installation consultation, (6) Start-up consulting service, and (7) Reactor service.

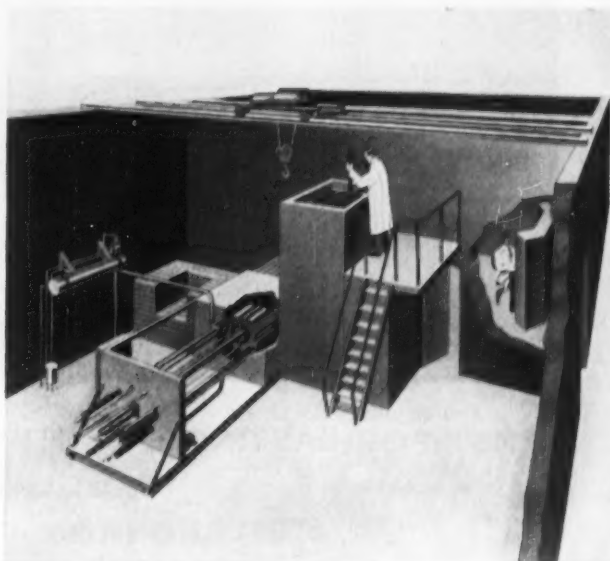
**FOR MORE INFORMATION** contact your nearest G-E Apparatus Sales Office, or write for bulletin GEA-6326, General Electric Co., Section C191-2, Schenectady 5, N. Y. Outside the U.S. and Canada, write to: International General Electric Company, 150 East 42nd, Street, New York 17, N. Y.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**

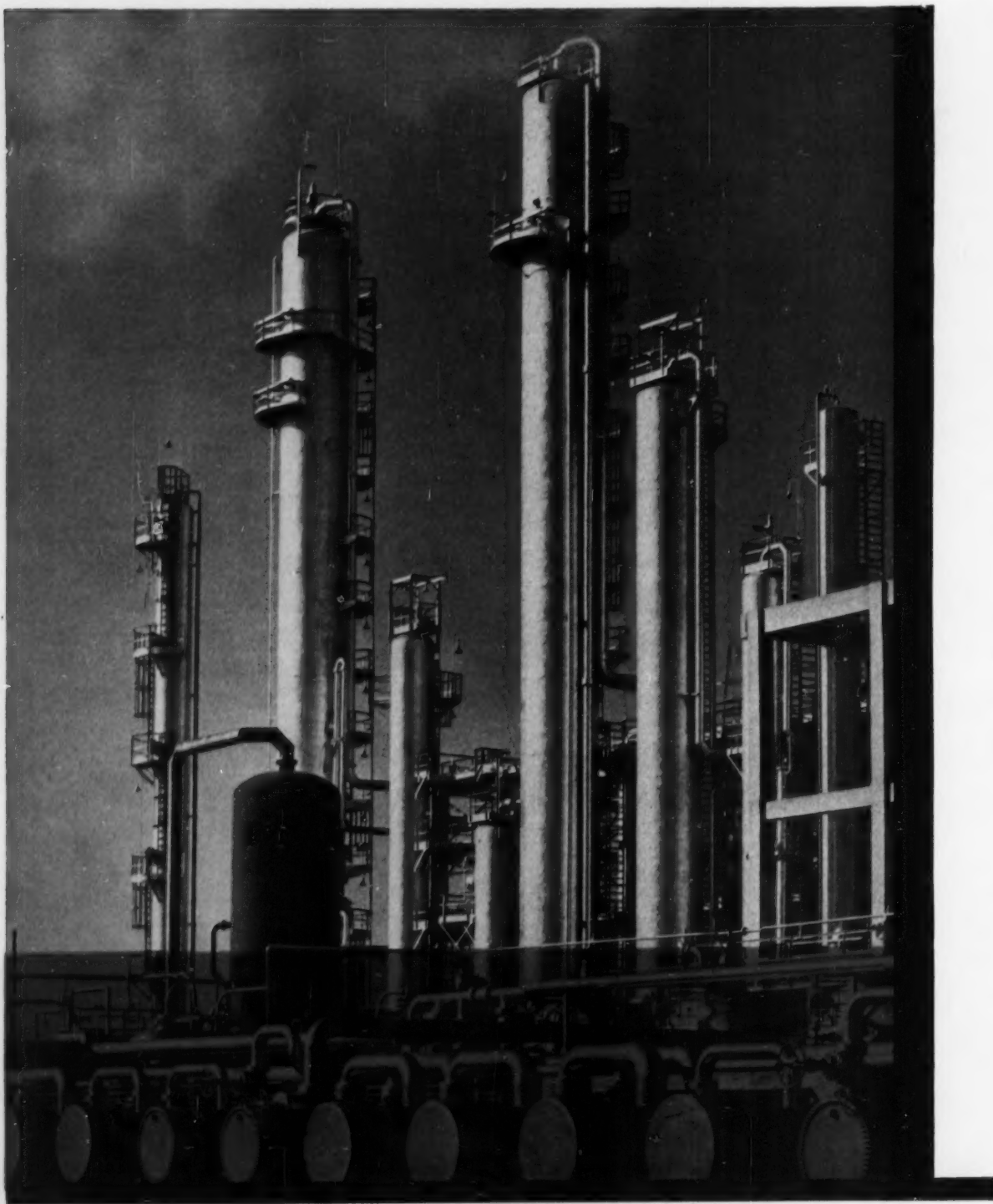


**SWIMMING-POOL REACTOR** has a neutron flux potential of  $10^{13}$  neutrons/cm<sup>2</sup>/sec. over a flux area of 3700 cm<sup>2</sup>. Fuel inventory consists of 3400 grams of enriched U-235.



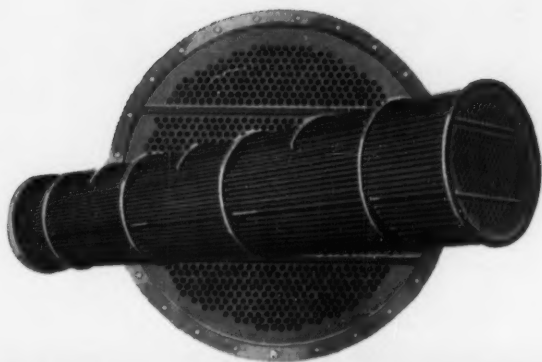
**NUCLEAR TEST REACTOR** has a flux level of  $10^{13}$  neutrons/cm<sup>2</sup>/sec. when operating at a power level of 30 kw. Fuel inventory for this reactor is 2500 grams of enriched U-235.





**FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!**





*For dependable "on-stream" performance . . .  
retube your exchangers with*

## **PHELPS DODGE HEAT EXCHANGER TUBES!**

Wide selection of copper-base alloys for every type of application—  
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Complete warehouse stocks maintained at Houston, Texas; Tulsa, Okla.;  
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Expert assistance in solving your tube corrosion problems.

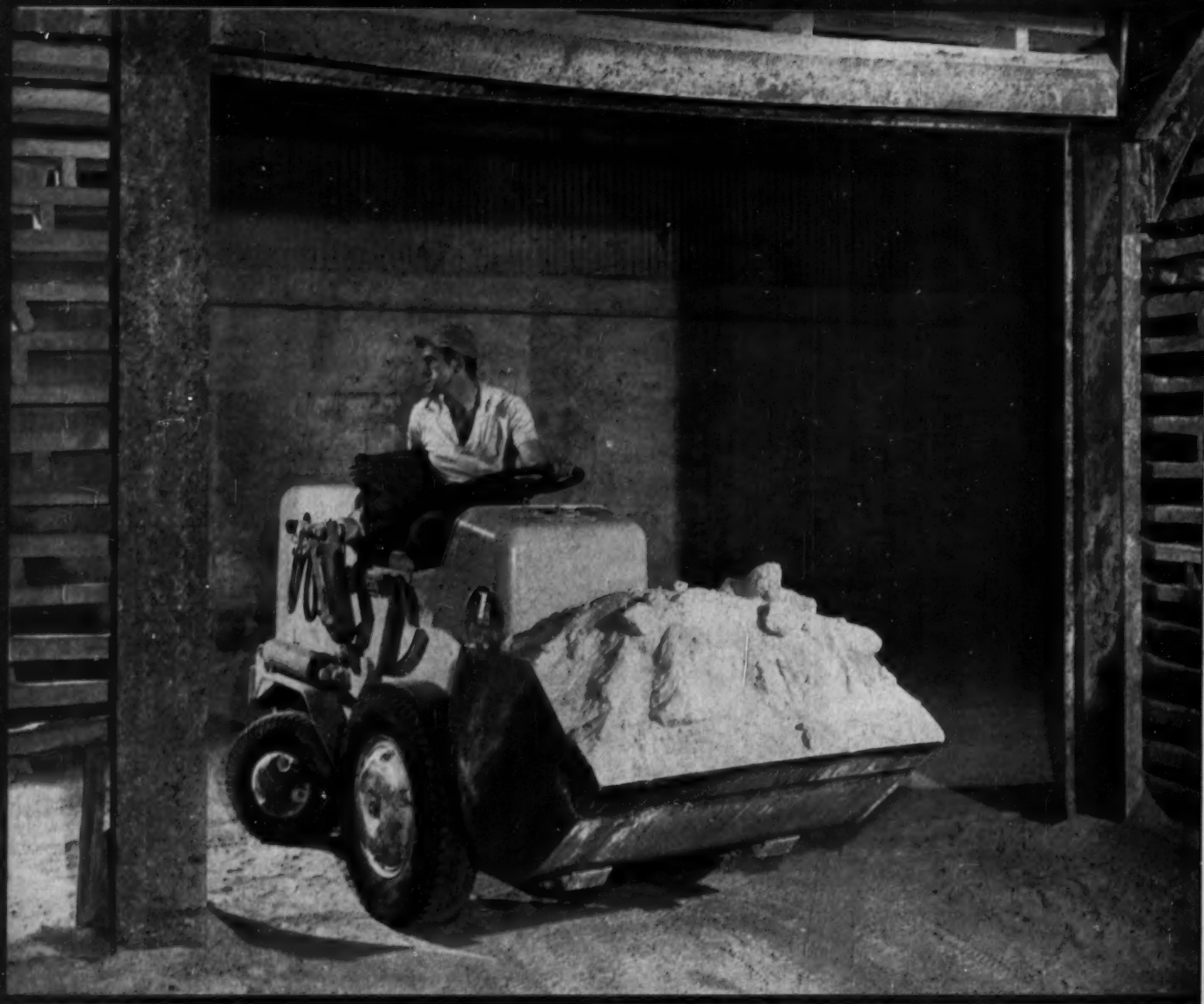
*Specify Phelps Dodge . . . One of the largest suppliers of tubes  
to manufacturers of heat exchangers!*



## ***PHELPS DODGE COPPER PRODUCTS*** **CORPORATION**

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# More Productive .

All kinds of processing and manufacturing plants are reporting exceptional satisfaction with the performance of the new-model HA "PAYLOADER" tractor-shovels. With their larger 18 cu. ft. buckets, they not only handle more tonnage of bulk materials than earlier models, but are way ahead of other front-end loaders in design and productivity — can deliver more tons per hour than heavier machines with larger engines.

Exclusive one-lever control handles tip-back, lift, dump and lowering of the bucket, simplifying and speeding operating cycles. The 40 degree tip-back of the bucket at ground level gets and holds big loads close and low without spilling. Hydraulic load-shock-absorber smooths the ride and permits higher travel speeds.

Fast, efficient and low-cost boxcar loading and unloading







Pick-up sweeper to clean floors, aisles, docks, and driveways

Special fine-buckets for odd pieces and "sifting" work



Lift-fork attachment for pallet loads

Push-fork attachment for spotting cars, skidding machinery, etc.



Barrels, carboys, bales, bags, drums also handled with bucket

Truck loading and unloading tool! Here shown unloading metal chips.



# .. More Versatile

Greater productivity is only half the story of the model HA, since it can be readily adapted to do many other jobs on either a part-time or full-time basis. Quickly-attached floor sweeper, fork-lift and pusher-fork attachments, plus

special buckets are available to further increase its usefulness and make this "PAYLOADER" one of the most versatile, profitable machines any plant can own.

The knowledge and experience gained during the past 30 years in building thousands of tractor-shovels — more wheeled tractor-shovels than all others combined — is your assurance of superior design, engineering and performance. The "PAYLOADER" line is also a complete line — a size for every purpose — bucket capacities from 14 cu. ft. to 2¼ cu. yd. There is also a nearby "PAY-LOADER" Distributor with complete parts and service facilities.



**PAYLOADER®**

MANUFACTURED BY  
**THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.**  
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY



**THE FRANK G. HOUGH CO.**  
734 Sunnyside Ave., Libertyville, Ill.

Send information on "PAYLOADER" tractor shovels as checked

☐ MODEL HA ☐ LARGER SIZES

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_



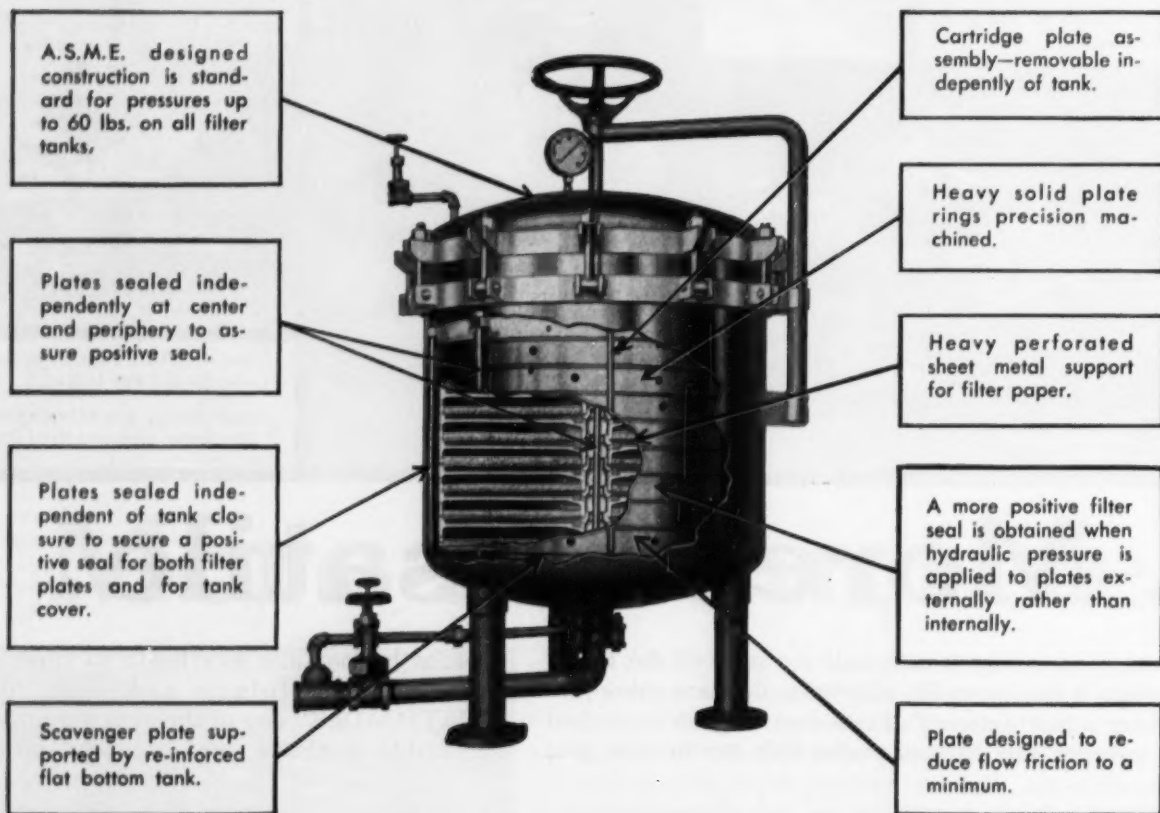


## Undisputed First Choice

with engineers who have had occasion to thoroughly test this type of filter. Shown here are structural features that are the result of over 30 years experience in building this one filter. If it could be made better or cheaper Sparkler would have made it that way long ago.



Aloysius C. Kracklauer  
Originator of the Horizontal Plate Filter



**SPARKLER  
FILTERS**

The Sparkler, original exclusive horizontal plate design and flow principle, has never been equalled for efficiency and dependability in filtering with any and all types of filter aids. The cake maintains its original position as formed regardless of pressure fluctuation flow rate or viscosity. No break-through is possible, even with a complete shut down of the filter. Filtering can be resumed with perfect safety at any time. With Sparkler plate construction a completely sanitary filter can be furnished.

**SPARKLER MANUFACTURING CO. MUNDELEIN, ILLINOIS**  
Sparkler International Ltd.—Manufacturing plants in Canada, Holland, Italy and Australia.  
REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD



# U.S.I. CHEMICAL NEWS

Nov.-Dec.

★

A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries

★

1956

## Diester Lubricants Best So Far for Jet Aircraft

### U.S.I. ISOSEBACIC® Acid Derivative Now Being Evaluated

A new diester formed by the reaction of U.S.I. ISOSEBACIC acid and 2-ethylhexyl alcohol is now being tested and shows promise as a lubricant for the fast moving parts of jet gas turbines. These lubricants must meet the stringent performance requirements of Military Specification MIL-L-7808 for satisfactory operation from 450°F down to -65°F — met most satisfactorily to date by diesters. The di-2-ethylhexyl ester of sebacic acid is most commonly used.

The chief advantage of the new diester is its derivation from unlimited petrochemical sources which can be counted upon to supply all needs at all times, even in emergency situations. U.S.I. ISOSEBACIC acid itself will be available in quantity when U.S.I.'s 10,000,000 lb. per year plant at Tuscola, Illinois comes onstream in mid-1957.

U.S.I. ISOSEBACIC acid is a mixture of isomers of sebacic acid in about these proportions:

2-ethyl suberic acid.....	72-80%
2,5-diethyl adipic acid.....	12-18%
sebacic acid.....	6-10%

In addition to the jet lubricant application, the material is being evaluated in vinyl resin plasticizers, polyurethane rubbers and foams, alkyd resins, nylon molding compounds and polyester resins. Samples can be obtained upon request.

## Photographic Prints from Diaz Process Improved By Urethan Addition

The diazotype process for reproducing written and illustrative material on light-sensitive paper has been improved by incorporating carboxamides such as urethan (ethyl carbamate) into the light-sensitive diazo layer. Material can now be processed at high speed, yielding prints which are well developed, stable on storage and standing, bright in appearance and which show no tendency to curl.

Commercial diazo equipment is usually operated at or near its maximum speed of 30 feet per second in order to get the greatest throughput. At this speed, prints have in the past been frequently underdeveloped and subject to fading on storage or standing.

Now these conditions are being eliminated by incorporation of compounds such as urethan into the light-sensitive diazo layer. The preferred amount of urethan incorporated ranges from 250-350 grams per liter of diazo coating solution.

This development is but one of a growing number of applications for this versatile chemical. Urethan, first produced commercially by U.S.I., is also finding many new uses in medicine and as a starting material for chemical and pharmaceutical synthesis.

## Dispersed Sodium Is Key to New Process for Rocket Fuels

### Process Uses Sodium Two Ways — as Reactant and as Heat Transfer Agent

Sodium and potassium borohydrides are being produced by a new process which starts with metallic sodium dispersed in an inert liquid hydrocarbon.

### Melting Points of Hafnium, Zirconium, Titanium Determined by New Technique

An improved technique for the accurate determination of melting points of metals in the temperature range 1500 to 2500°C has recently been announced which sets the value for zirconium at  $1855 \pm 15^\circ\text{C}$ , for titanium at  $1668 \pm 10^\circ\text{C}$  and for hafnium at  $2222 \pm 30^\circ\text{C}$ . The improvements consist of gradient heating and refinements in cavity preparation to obtain true black-body conditions. Reproducibility of results is claimed to be  $\pm 3^\circ\text{C}$ .

Although M.P. values for zirconium and titanium have been obtained which are fairly constant from one investigator to another, the value for hafnium has varied widely. Temperatures of  $1975 \pm 25^\circ\text{C}$ ,  $2430^\circ\text{C}$  and  $2230 \pm 50^\circ\text{C}$  have been reported. This new method was developed primarily to fix an accurate melting point value for hafnium, and has been applied to zirconium and titanium as a matter of interest.

The technique is a modification of the general tungsten suspension method, whereby a small specimen is suspended by a fine tungsten wire in a slender, induction-heated tungsten or tantalum cylinder, under vacuum. U.S.I. has special interest in this refinement since it is constructing two new plants to produce titanium and zirconium as well as a hafnium oxide by-product. The sodium reduction process used for these metals is also capable of producing hafnium.

## Polyethylene Drums Okayed by ICC for Certain Shipments

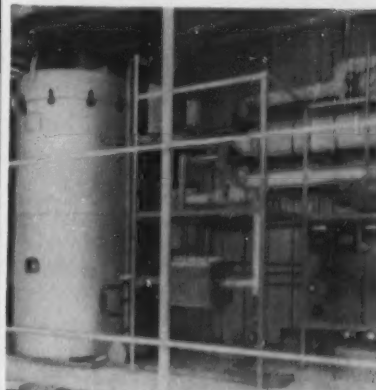
Molded polyethylene drums have recently been approved by the Interstate Commerce Commission for commercial shipment of these regulated products: alcohols, acids or other corrosive liquids not specifically provided for, hydrochloric acid, hydrochloric acid mixtures, hydrochloric acid solutions, sodium chlorite solutions, hydrofluorosilicic acid, hydrofluoric acid, sulfuric acid, hypochlorite solutions, formic acid, formic acid solutions.

Those who wish to use polyethylene drums for the shipment of regulated products not listed above should apply to the Bureau of Explosives, 30 Vesey Street, New York, N. Y. for temporary permits. Nonregulated product shipments by road and rail were approved by the ICC early in 1955.

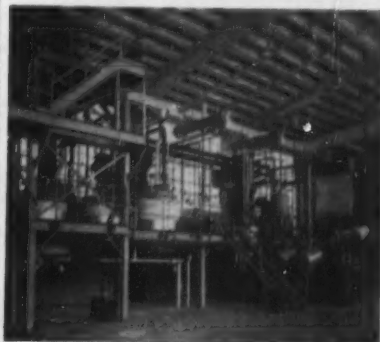
A semi-commercial plant now in operation is getting yields of about 95% on sodium borohydride (based on methyl borate), and up to about 90% on the potassium compound (based on contained  $\text{KBH}_4$ ).

Borohydrides have been in the news lately as intermediates in the preparation of diborane, precursor of pentaborane rocket fuel. They are also achieving recognition among drug and fine chemical manufacturers as selective reducing agents for certain organic compounds, where undesirable side reac-

**MORE**



Heat supply system for sodium borohydride plant using the sodium-potassium alloy NaK as heat transfer fluid. Furnace, electromagnetic pump and heat exchangers are shown. Photo courtesy of the Callery Chemical Company.



Reactors (left) and condensers (right) for sodium hydride preparation. Photo courtesy of Metal Hydrides Incorporated.



Nov./Dec. ★

# U.S.I. CHEMICAL NEWS

★ 1956

## CONTINUED Sodium

tions must be avoided. A recent article also indicates possible use for sodium borohydride as a pulping agent in the paper industry.

### Sodium Hydride Formed First

In the new process, molten sodium and a refined, high-boiling mineral oil are agitated with high shear and heated in a hydrogen atmosphere. This breaks the metal into tiny particles which react with the hydrogen gas to yield finely dispersed sodium hydride coated with oil. Methyl borate is then added to produce a mixture of sodium borohydride and sodium methoxide. The sodium borohydride is then solvent extracted and dried.

Where the potassium compound is desired, an aqueous potassium hydroxide solution is added to the mixture of sodium derivatives to precipitate potassium borohydride.

A circulating sodium-potassium (NaK) alloy system is used to heat the reaction mass. The liquid metal is heated in a furnace, dissipates its heat in a heat exchanger, and is circulated back through the furnace. Circulation is provided by an electromagnetic pump which has no stuffing boxes and is therefore not subject to the usual leakage and maintenance problems of ordinary pumps.

### Dispersions Have Advantages

The sodium dispersion technique, originally developed to commercial feasibility by U.S.I. contributes several very important advantages in the new process:

- Rate of hydride formation is faster.
- The oil coating makes the hydride easier to handle.
- Reaction of the hydride with methyl borate is 10 times faster, proceeds efficiently, doesn't require excess hydride.
- Oil absorbs heats of solution and reaction, prevents decomposition which might result from overheating.

U.S.I. Technical Service Engineers, with experience gained in the company's sodium production facilities, have worked with two new borohydride producers in developing their plant and process designs.

## Flexographic Printing Gets New "Voice"

### Alcohol Use in Inks Reviewed

This September the first trade magazine devoted exclusively to flexographic printing made its debut. Called "Flexography", the magazine was created to meet the demands of this fast-growing industry for information on materials, techniques and equipment.

Flexography, a form of letterpress printing, uses rubber plates instead of metal and fluid inks which dry by solvent evaporation. An article on these inks and their formulation appears in the first issue of the new publication and should be of interest to all printing ink manufacturers.

### U.S.I. Filmex® Used in Flexographic Printing

Proprietary ethyl alcohol, according to the article, is the most versatile and commonly used solvent for the colorants and vehicles which go into flexographic inks. U.S.I. makes an alcohol formulation known as FILMEX® which was specifically designed for this application. It is carefully formulated to eliminate all trace of hydrocarbons which might soften or otherwise deteriorate rubber plates and rolls. FILMEX® is one of the most reliable solvents on the market for the purpose.



**ZIRCONIUM, TITANIUM WILL BE MADE HERE**  
To house U.S.I.'s new 10 million pound-per-year titanium sponge plant as well as its 1.5 million pound-per-year zirconium sponge plant, the company has recently purchased this 175,000 square foot building at Ashtabula, O., near the existing U.S.I. sodium-chlorine plant. Acquisition of the giant building is expected to cut six months to a year from U.S.I.'s construction time table.

## TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing the Editor, U.S.I. Chemical News.

**Basic formulations for a new type aerosol skin bandage** are now being offered to aerosol marketers and contract fillers in the drug field. After spraying on, the dry films reportedly adhere well, are transparent and tough. **No. 1180**

**"What's Available on Microprint Cards"**, a free 8-page booklet, can now be obtained which lists the technical literature which has been put out in this form. This bibliography is divided by subject, includes works on chemistry, mathematics and physics among others. **No. 1181**

**A 125-page report on sirconium** can be purchased which covers its chemistry, properties, production and fabrication—from both the economic and technological standpoints. **No. 1182**

**New synthetic resins in 2 types—**anionic and cationic—are offered as permselective ion exchange membranes. Other possible uses are suggested by film properties of strength, toughness, flexibility and freedom from static. **No. 1183**

**A summary on amine acid research** can now be purchased which covers: the effects of DL-methionine supplements on animals; the effects of amino acid imbalance on maintenance and growth; and the amino acid needs of children. **No. 1184**

**Acrylic thickener** recently developed is shipped as high-solids, low viscosity acidic emulsion, is diluted and neutralized to clear, viscous, low-solids solution at point of use. Said to have long-term stability. **No. 1185**

**Radioactive phenol—C<sup>14</sup>** (uniformly labelled) is now being offered as a tracer or synthetic intermediate in studying plant and animal chemistry, and as an aid in analyzing products such as insecticides, medicinals, plastics. **No. 1186**

**Polyethylene-based ointments** containing antibiotics and other pharmaceuticals are now available. Polyethylene replaces petroleum in part in these preparations, and is said to release more medicine at a slower rate. **No. 1187**

**The dipotassium salt of (ethylenedinitrilo) tetracetic acid** is now offered as a chelating agent. Has better solubility in alcohol than the sodium salt. Material is a white solid, soluble in water. **No. 1188**

**A new gun for extruding caulking compounds** has been devised in which air pressure forces the compound out of a disposable polyethylene cartridge through a polyethylene nozzle screwed to it. Smooth, automatic operation is claimed. **No. 1189**

## PRODUCTS OF U.S.I.

### INORGANIC CHEMICALS:

**Sodium, Metallic** cast solid in tank cars, steel drums, pallets; bricks in barrels, pails.  
**Chlorine** liquid, in tank cars.  
**Caustic Soda** 50% liquid, in tank cars.  
**Sodium Peroxide** dust-free granules, in drums.  
**Sulfuric Acid** all strengths, 60° Baumé to 40%. Also Electrolytic grade to Federal specifications. Tank cars or tank wagons.  
**Ammonia** Anhydrous, commercial and refrigeration. Tank cars or tank wagons. Also Nitrogen Fertilizer Solutions.

### OTHER PRODUCTS:

**Alcohols:** Ethyl (pure and all denatured formulas), Normal Butyl, Amyl, Fossil Oil; Proprietary Denatured Alcohol Solvents SOLOX®, FILMEX®, ANSOL® M, ANSOL® PR.

### PETROTHENE® Polyethylene Resins.

**Esters, Ethers and Ketones:** Normal Butyl Acetate, Dibutyl Phthalate, Diethyl Carbonate, Diethyl Oxalate, Ethyl Acetate, Ethyl Ether, Acetone.

**Intermediates and Fine Chemicals:** Acetoacetylides, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate solution, Urethan USP (Ethyl Carbamate).

**Animal Feed Products:** Calcium Pantothenate, Choline Chloride Products, Curbay B-G® 80, Special Liquid Curbay®, DL-Methionine, Nicotin USP, Riboflavin Concentrates, Vitamin B<sub>12</sub> and Antibiotic Feed Supplements, Vacatone® 40, Vitamin A, D<sub>3</sub> and K<sub>3</sub> products.

**Pharmaceutical Products:** DL-Methionine, N-Acetyl-DL-Methionine, Riboflavin USP, Urethan USP, Intermediates.

### U.S.I. SALES OFFICES

Atlanta • Baltimore • Boston • Buffalo • Chicago • Cincinnati  
Cleveland • Dallas • Detroit • Houston • Indianapolis • Kansas City, Mo.  
Los Angeles • Louisville • Minneapolis • Nashville • New Orleans  
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**INDUSTRIAL CHEMICALS CO.**

Division of National Distillers Products Corporation

99 Park Avenue, New York 16, N. Y.





# PROPORTIONEERS

# NEW!



## CHEMICAL PROPORTIONING PUMP

Model 1140 Proportioneer

Discharge Pressures up to	MAXIMUM CAPACITY PER CYLINDER IN GPH* (Minimum feed rate 1/15th of max. cap. by stroke length adjustment)					PRICE
1340 psig.	10.7	13.3	17.8	21.3	26.6	
670 psig.	20.9	26.1	34.8	41.8	52.2	
335 psig.	42.7	53.3	71.1	85.3	106.5	
168 psig.	83.6	104.4	139.2	167.1	209.0	
84 psig.	171.0	213.0	284.5	342.0	426.0	

\*Five operating speeds available for various fluid viscosities. For capacities of DUPLEX MODELS (see photo), double the capacities shown in table. If you need capacities and pressures other than these, consult Proportioneers, Inc., manufacturer of the most complete line of proportioning pumps.

*Like surprises?  
Write for  
Prices!*



## B-I-F INDUSTRIES

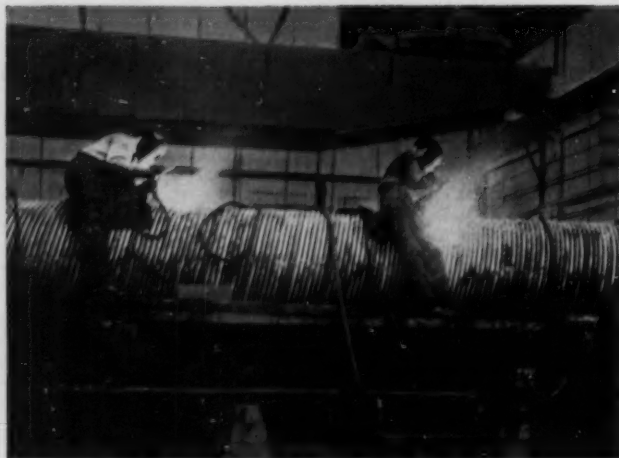
PROVIDENCE, RHODE ISLAND



METERS  
FEEDERS  
CONTROLS

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.



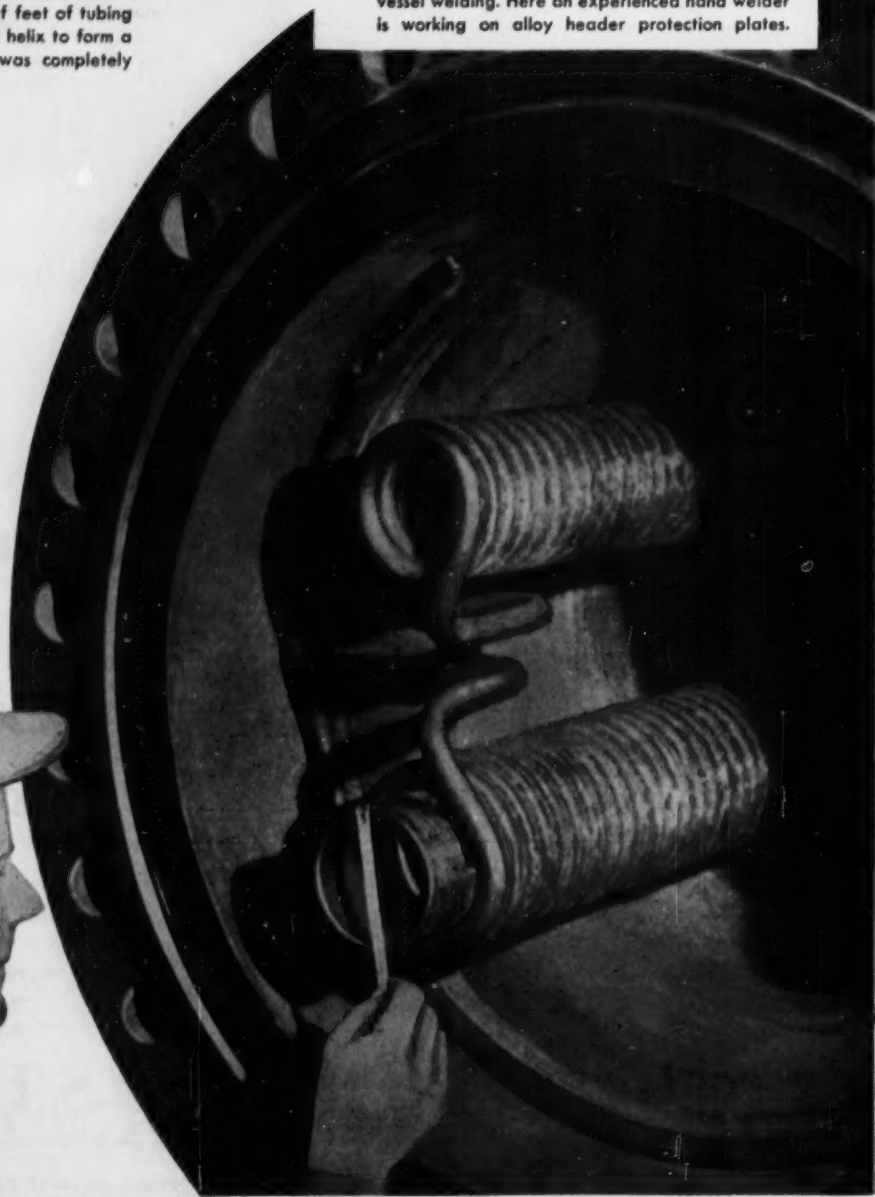


▲ In the fabrication of special combination reactor and heat exchanger, thousands of feet of tubing had to be precisely wound into a helix to form a baffle. The seam of the helix was completely welded inside and out.



▲ B&W pioneered the development of pressure vessel welding. Here an experienced hand welder is working on alloy header protection plates.

Measuring peep sight coils, which are located in manway of main drum.







▲ The precision bending of tubing to form this pancake coil required unusual shop skills.



▲ Manufacture of the header protection coil involved many special techniques in bending and welding.

**B&W's Engineering and Manufacturing Skills  
Produce Something New and Different In**

## **PRESSURE VESSELS...**

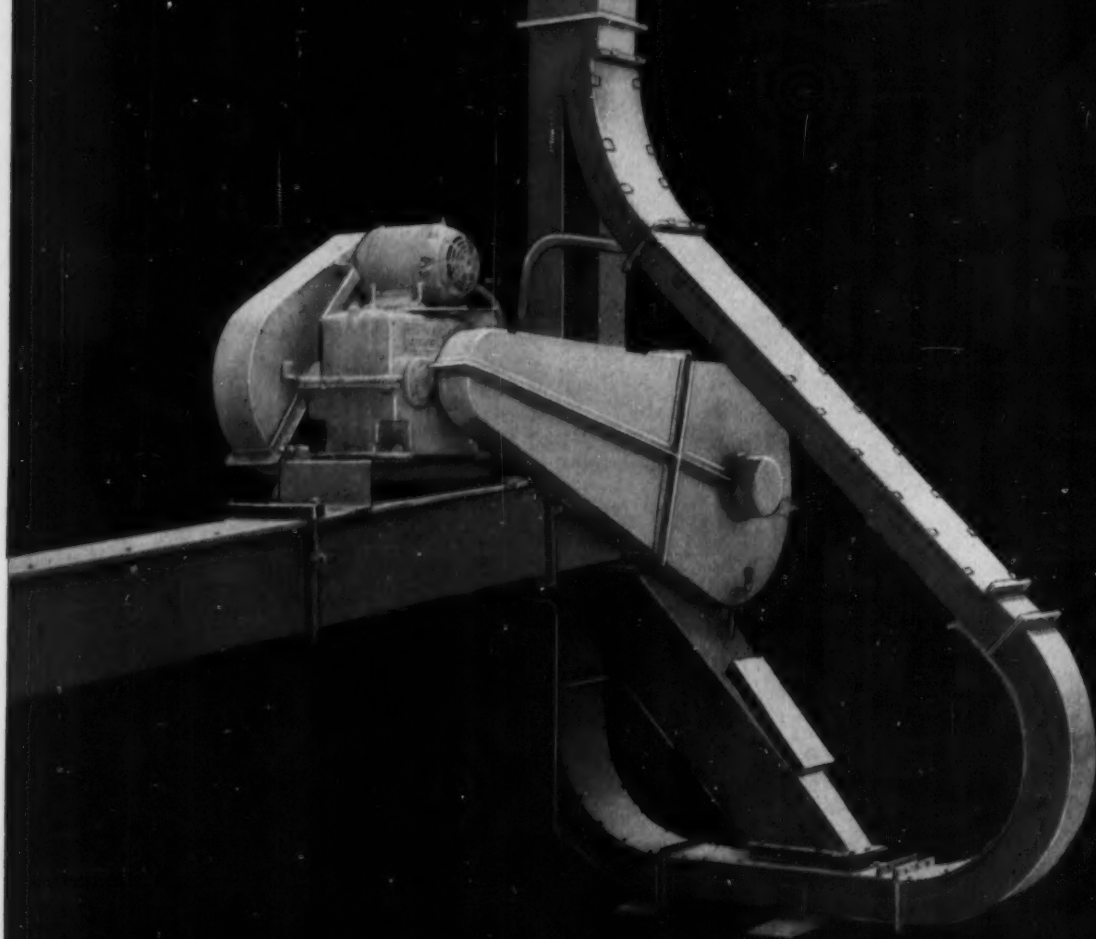
Designing and manufacturing the equipment for a special combination reactor and heat exchanger for a petro-chemical plant required something unusual in the way of engineering and manufacturing skills. B&W design and manufacturing engineers contributed materially to the solution of these problems through their techniques, skills and depth of experience accumulated in producing thousands of pressure vessels, boilers, refractories, burners and tubing, of all types and for virtually every application.

The design and fabrication of this complex unit is but one example of how B&W blends engineering skills and unexcelled facilities—backing both with continuing research in many areas. Because B&W has long been meeting the special requirements of modern chemical, petroleum and steam generating operations, you will receive the ultimate in engineering and experienced craftsmanship when you bring your process equipment problems to B&W. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.





# STEPHENS-





# - ADAMSON

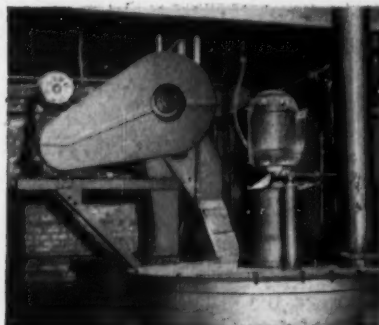
## *chemical product conveying systems*

For more than half a century, S-A engineering talent and equipment have been handling the toughest conveying assignments for the vast chemical processing industry. The lessons taught by these years of experience are reflected in sound S-A equipment design and the most expedient approach to every conveying problem.

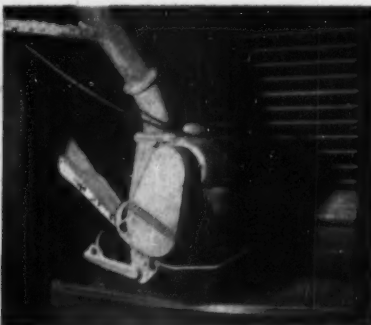
Stephens-Adamson bulk materials handling systems characteristically conform to highest standards of product protection, speed, safety in operation, and economy of

movement. There is the broadest possible line of manufactured conveying products to select from in laying out any material handling system.

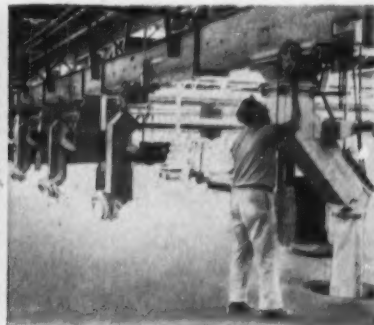
Whether it's design and installation of a completely new system or the revision and modernization of an old or inadequate one, S-A can help you save cost on every ton of material you move. Consult the sales engineer in your area. He can show you why it's wise to convey the S-A way.



Closeup view of REDLER head section showing a SACO speed reducer on drive. S-A builds a wide range of power transmission equipment for conveyor use.



Swivel loader insures uniform loading to maximum capacity. S-A builds five basic types of equipment for loading and unloading ships and box cars.



A big chemical processing plant employs REDLER conveyors to carry material completely enclosed and protected. Here material is discharging through pivoting chutes to mixers.



## STEPHENS-ADAMSON MFG. CO.

3 RIDGEWAY AVENUE, AURORA, ILLINOIS

LOS ANGELES, CALIFORNIA

BELLEVILLE, ONTARIO

S-A manufactures a wide range of material handling products in three complete plants in the U. S. and Canada.

Belt Conveyors  
Belt, Pan & Plate Feeders  
Ship Loading Boom Conveyors  
Stacking Conveyors  
Storage & Reclaiming Systems  
"Natural Frequency" Vibrating Conveyors  
REDLER Conveyor-Elevators  
ZIPPER Conveyor-Elevators  
Conveyor Belt Cleaners

Headshaft Holdbacks  
Grizzlies & Screens  
Centrifugal Pilers  
Bin Gates & Tunnel Gates  
Car Pullers & Spotters  
Bucket Elevators  
Skip Hoists  
SEALMASTER Ball Bearing Units

• Write for a bulletin on any of the above products.



# New **TRAILMOBILE** acid



*The secret is exterior ring design!* ►



**tank trailer...**

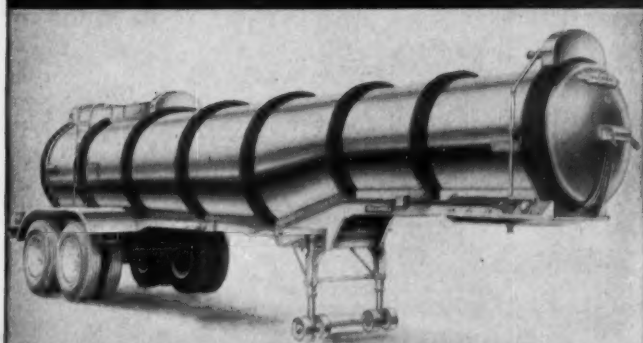
**has THOUSANDS of  
POUNDS more  
payload capacity**

*The new Trailmobile Model CH Acid Tank Trailer gives you big, extra payload capacity amounting to as much as 100 pounds for every 100 gallons of capacity built into the tank.*

**The secret is exterior ring design!** Brawny rings of steel reinforce the new light gauge shell allowed by regulation codes. This unique design lightens the trailer by thousands of pounds while retaining structural strength.

This new Trailmobile Model CH incorporates every money-saving feature of previous Trailmobile models. It is available in high tensile steel, stainless steel or aluminum with a variety of coatings and linings to handle all types of corrosive and non-corrosive fluids. Insulated models are also available where load temperatures need to be maintained.

*Check on the CH before you buy.* TR-478



**TRAILMOBILE INC.**

*Cincinnati 9, Ohio • Springfield, Missouri  
Longview, Texas • Berkeley 10, California*



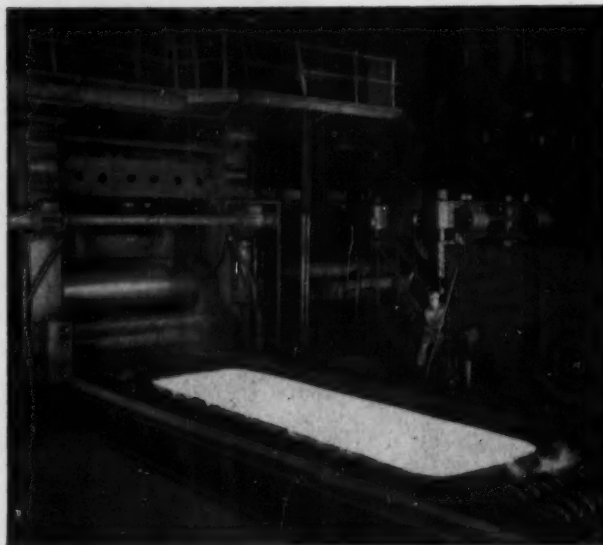
# step by step...

## CLAYMONT BUILDS QUALITY INTO

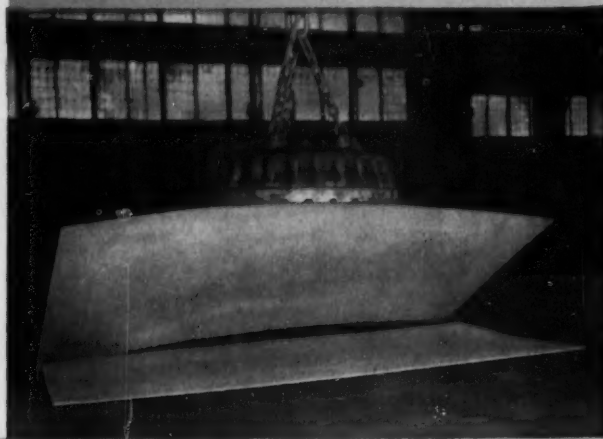
■ Dependability and economy are two characteristics of *every* stainless-clad product that bears the Claymont name. These characteristics are assured by Claymont's careful quality control system—a system that step-by-step builds superior quality into *every* Claymont Product.



**1.** Skilled metallurgists begin testing Claymont steel long before it leaves the open hearths to make sure that it is never "off-heat". This supervision never ceases until the stainless-clad product is finally shipped.



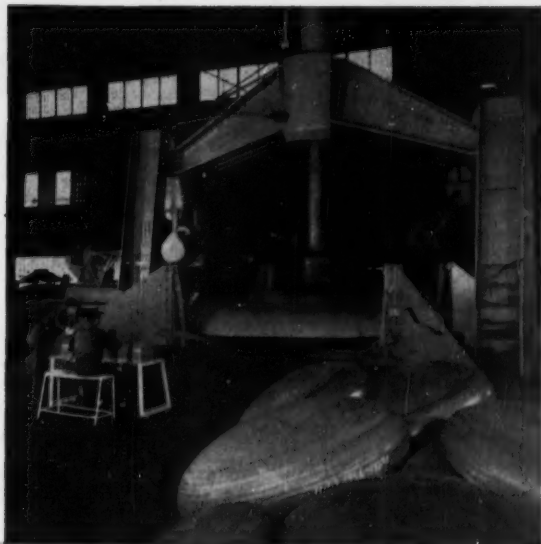
**2.** First step in making stainless-clad plates is to assemble a "sandwich"—composed of two stainless steel plates between two carbon or alloy steel backing plates. Next, the sandwich is slowly heated to 2250° F and rolled as a single unit, permanently bonding each stainless plate to its backing plate. A special compound between the stainless plates keeps them from fusing together.



**3.** After a controlled cooling period, the assembly is sheared or burned, then separated producing two stainless-clad plates. They are then carefully heat treated, resheared to exact size, sandblasted, and inspected.

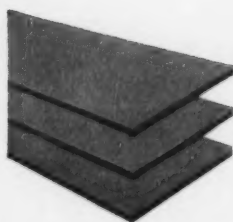


# ITS STAINLESS-CLAD PRODUCTS



**4.** Claymont Stainless-Clad Steel Heads are spun or pressed in sizes up to 19 feet and in a wide variety of shapes—flanged and dished, elliptical, conical, hemispherical, etc. Shown here are two units in Claymont's extensive head-forming facilities—a large spinning machine and a new, automatic 3000-ton press.

## OTHER CLAYMONT PRODUCTS



**Steel Plates**  
Alloy • Nickel Plated •  
High Strength Low Alloy



**Fabricated  
Steel Parts**



**Manhole Fittings  
and Covers**



**Large Diameter  
Welded Steel Pipe**



## Claymont Steel Products

Products of Wickwire Spencer Steel Division • The Colorado Fuel and Iron Corporation

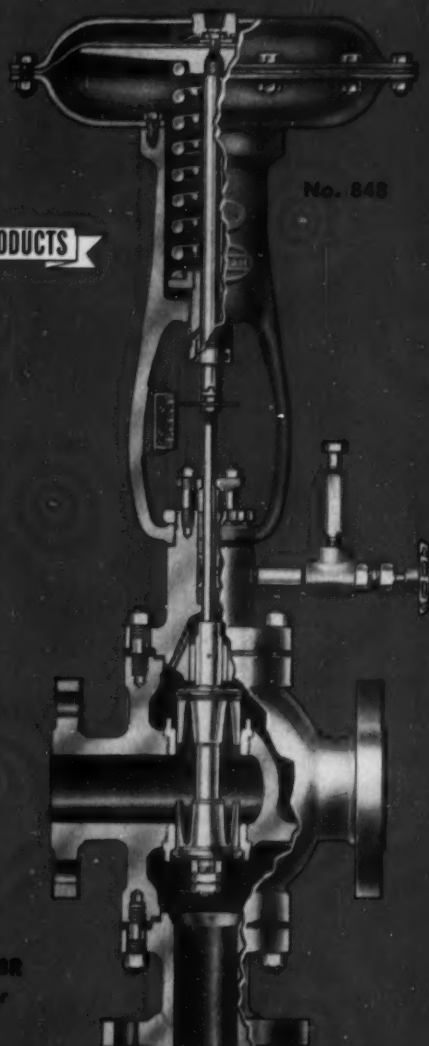
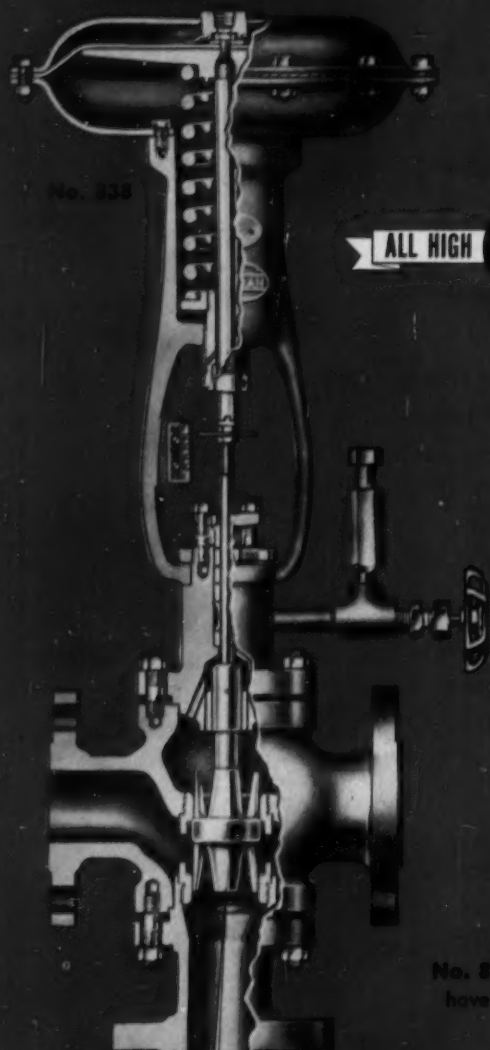
Albuquerque • Amarillo • Atlanta • Billings • Boise • Boston • Buffalo • Butte • Casper • Chicago • Denver • Detroit • El Paso • Ft. Worth  
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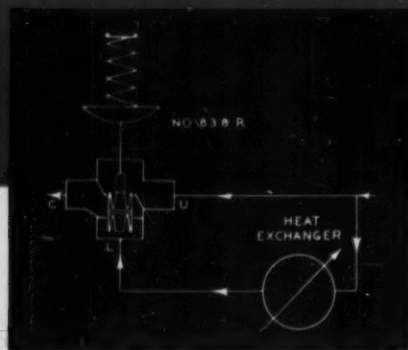
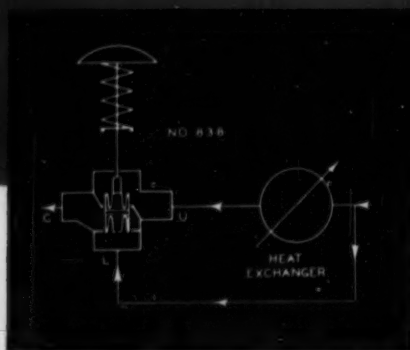
4449





ALL HIGH *Quality* *Construction* PRODUCTS

No. 838R and 848R  
have reverse motor



#### Combining Service

In these typical applications of Masoneilan 3-way valves, No. 838 and 838R (above) are installed downstream of a heat exchanger for combining service; and No. 848 and 848R (shown on next page) are installed upstream for diverting service. In combining, the heating medium is brought in through ports U and L and out through common port C. In diverting, the fluid is brought in through port C and out through ports U and L.



**Select Masoneilan 3-Way Control Valves to get...**

## **Stability and Flexibility In Combining or Diverting Service**

**Choice of seating arrangement** permits installation to obtain the inherent stability (and maximum allowable pressure drop) of flow tending to open both ports. No. 838 and 838R use a single seated body and a plug with seats back to back *inside* the seat rings. No. 848 and 848R use a modified double seated body and a plug with seats face to face *outside* the seat rings. Plugs are *top* and skirt guided for more accurate alignment and long service life.

**Choice of motors** permits obtaining maximum operating force, with same available thrust at both ends of the stroke or with a high thrust in one direction if desirable. 3-15 or 6-30 psi spring ranges and availability of oversize diaphragm cases allow a wide selection of motors, either direct or reverse. Enables you to choose, also, the action providing greatest safety factor in the event of air failure.

A more detailed discussion of these valves is available. Write our office nearest you, or

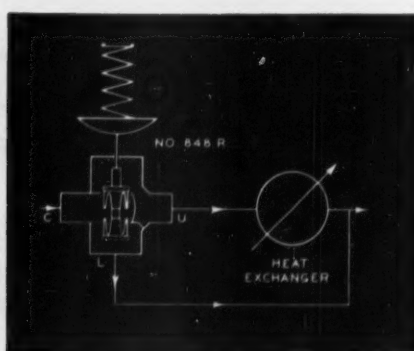
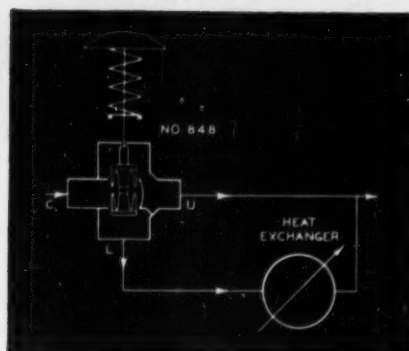
### **MASON-NEILAN**



Division of Worthington Corporation

67 HANATAN STREET, NORWOOD, MASSACHUSETTS

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa  
Philadelphia • Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati • Kansas City • Phoenix  
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Los Angeles • Corpus Christi • Denver • Appleton • Birmingham • New Orleans • Seattle  
Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



#### **Diverting Service**

Since maximum unbalance occurs across the bypass port, motor action is normally selected so that an increase in diaphragm pressure will tend to close the bypass port. The flow direction shown in all these diagrams tends to open both ports and maximum motor operating force is available to overcome off-balance. The valves are arranged so that the heating medium to the exchanger will be shut off in the event of air failure.





Now to supply both .....

# Power

Clark introduces .....

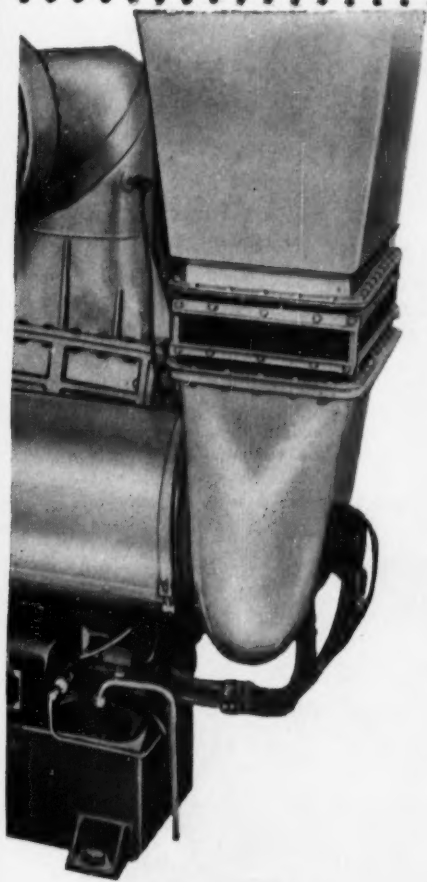
### Mark TA Features

- Quick starting**—2 minutes to full load
- Quick shutdown**—instantaneous—no turning gear
- Field proved**—forty units delivered
- Light weight**—less than 6 tons
- Compact**—only 16' long, portable
- Long life**—conservative blade temperatures
- Air cooled**—long life—cool outer surface
- Packaged**—shipped assembled, ready to install
- Fuel versatility**—liquid or gaseous
- Installation flexibility**—up or down duct connections
- Variable speed**—physically separated turbines
- Single combustion chamber**—lasts a lifetime



# and **Steam** the **Mark TA** Gas Turbine

.....



Power to drive a generator, pump or centrifugal compressor and low or high pressure steam for process use . . . the new Clark Mark TA 1130 bhp gas turbine will do both when equipped with a waste heat boiler. In addition to the 1130 bhp of rotative energy the turbine-boiler package will deliver 9500 lbs. of steam per hour at a combined fuel utilization of up to 79%. It's the most modern, compact and efficient power plant combination you can install!

The new turbine is also well suited to driving rotative loads without a waste heat recovery system. Its light weight, compactness and quiet, practically vibrationless operation makes it ideal for marine or portable use as well as for permanent installation.

Your nearest Clark representative will be pleased to give you all the facts about Clark gas turbines in sizes to 8500 bhp, or write for bulletin 142.

**CLARK BROS. CO.     OLEAN, NEW YORK**

*One of the Dresser Industries*

Offices in Principal Cities Throughout the World

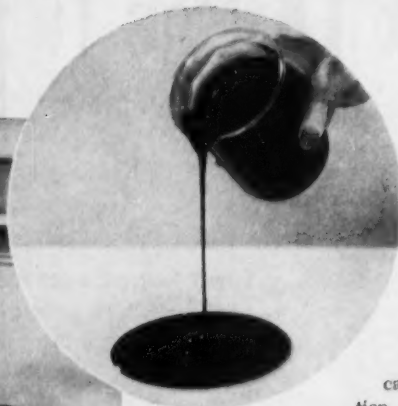
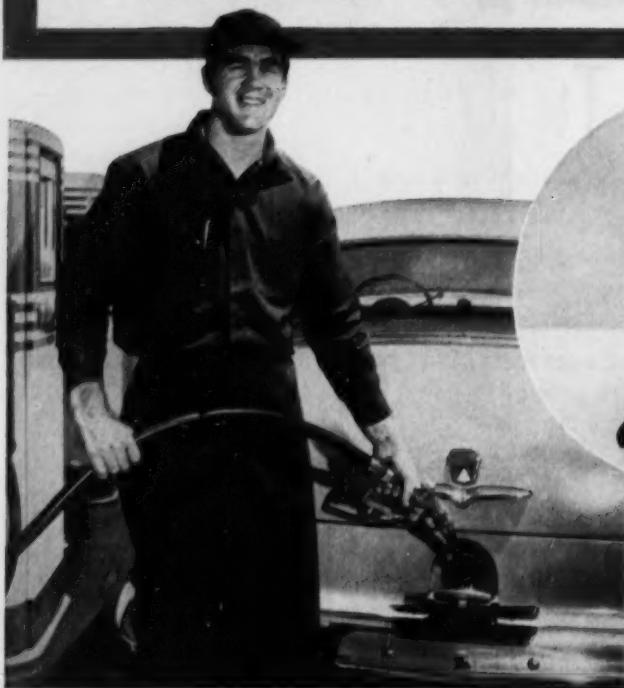
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®



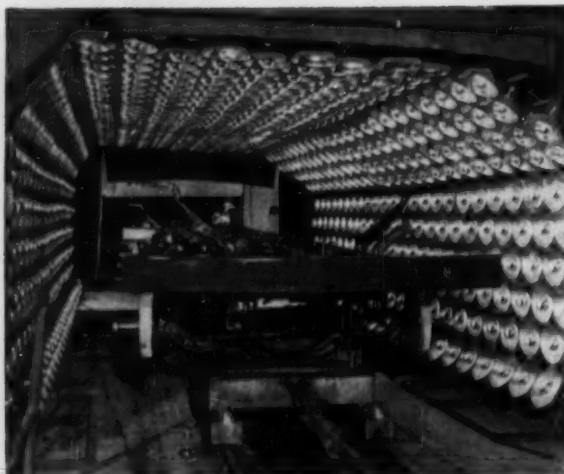
**Gas Turbines**



# Life ...on the Chemical Newsfront



**RESIDUAL OILS BECOME GASOLINE** in the rapidly expanding refinery process of catalytic hydrogen desulfurization. With the aid of Cyanamid's HDS Catalysts, refinery by-product hydrogen removes as  $H_2S$  the high sulfur content of still residues. In addition, hydrocracking produces gasoline-range products and gas oils suitable for conventional cracking. Cyanamid's HDS Catalysts are a cobalt-molybdena type designed to combine maximum catalytic efficiency with physical characteristics that provide maximum catalyst life and throughput. (Refinery Chemicals Department)



**FASTEST DRYING PAINTS EVER MADE** are formulated from styrenated alkyd resins modified with Cyanamid's Acrylonitrile. Baking enamels can be dried in five minutes at  $300^\circ F$ . Typical air-dry paints are dust-free in 5-10 minutes, tack-free in 10-15 minutes, and hard-dry in less than half an hour. These fast-drying films are harder and tougher, more resistant to chemicals and solvents, and display remarkable resistance to bronzing and chalking. The use of Acrylonitrile as a co-monomer has similarly improved physical and chemical properties in a wide range of products. (Organic Chemicals Division)



**THE MEDITERRANEAN FRUIT FLY** seriously threatened the Florida citrus industry this summer. It is being controlled with area-wide aerial and ground spraying with Malathion, Cyanamid's recently developed broad-spectrum insecticide. View above shows spraying in the Miami Beach area. When the "Medfly" last invaded Florida in 1929, 75% of the state's citrus crop had to be destroyed in a two-year drive to effect control of the infestation. Malathion-bait spray is expected to control the infestation efficiently without such drastic loss to Florida's agriculture. (Agricultural Chemicals Division)





**NEW HEIGHTS IN SAFETY AND STRENGTH:** Putnam Rolling Ladder Company utilizes sandwich construction of glass fiber and LAMINAC® Polyester Resin to create lightweight ladders with nonconducting properties that make them ideal for power and electrical work. Non-corrosive properties and superior strength recommend these ladders for chemical plants—in fact, they're excellent for any kind of plant under any kind of condition. LAMINAC Resin and glass fiber are also combined in the fabrication of boats, chemical processing tanks, structural building panels and automotive equipment.  
(Plastics and Resins Division)



**ADD SPARKLING WHITE GIFT WRAPPERS** to the applications for "whiter-than-white" papers made possible with Cyanamid's CALCOFLUOR® PHS Concentrate optical brightener. Where eye-appeal counts, papers treated with CALCOFLUOR stand out because the ultraviolet portion of light is converted into a visible blue-white, adding whiteness and brightness to the paper. CALCOFLUOR optical brighteners are well established as textile and detergent aids. Their use is also rapidly increasing in paper because of the unequalled contrast given to typography and illustration by these brilliant white papers.

(Organic Chemicals Division)

®Trademark



*Additional information may be obtained by writing on your letterhead to the Division of American Cyanamid Company indicated in the captions.*

***Building for the Future  
Through Chemistry***





The



# Man from St. Regis says:

"It's an amazing new concept in packaging...the  
**FLUOPACKER FILLING MACHINE**"

Available in 1 to 4-tube models, the Fluopacker Filling Machine packs powdery and granular materials alike at high speeds, with accurate weights, into smaller, cleaner bags.

The secret is Fluidizing . . . an exclusive process that sends low pressure air (1-3 psi) through a canvas air pad to the bottom of the supply bin. Once material is "fluidized" it flows out through filling tube due to the difference in "pressure head" between bin and bag.

Here are some of the ways that the Fluopacker Filling Machine gives you easier, more economical packaging:

**EASIER, FASTER OPERATION AND HANDLING** . . . automatic controls fill up to 20 bags a minute . . . bags are easier to handle, palletize and transport—help you make more efficient use of warehouse.

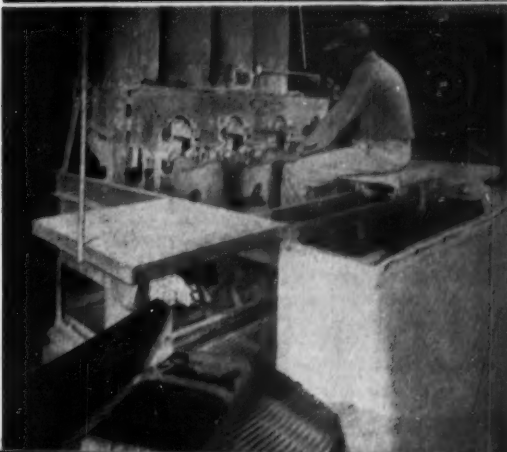
**BAG COST SAVINGS** . . . Aeration of the product by *fluidizing* actually is less than by conventional filling methods—results in denser product, smaller bag sizes.

**DUST-FREE OPERATION** . . . Dust leakage around the filling tube is prevented by use of an expandable rubber seal between the valve of the bag and filling tube . . . danger of toxic or silicosis hazards are minimized.

Four-tube Fluopacker Filling Machine at G. & W. H. Corson's Plymouth Meeting, Pa. plant accurately weighs and packs 50-pound valve bags at rates up to 18 per minute. Corson reports "the Fluopacker Filling Machine enables us to cut bag size the equivalent of three inches in length, gives us a better package and saves money!"

## St. Regis PAPER COMPANY

*Behind the Man from St. Regis stand experts in every field of packaging, ready to serve you.*



Multiwall Packaging Division  
St. Regis Paper Company, Dept. CE-1256  
150 East 42nd Street  
New York 17, N. Y.

Please send me free illustrated booklet on the Fluopacker Filling Machine.

Name \_\_\_\_\_ Title \_\_\_\_\_  
Firm \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_





## Coal Chemicals Follow the March of

The past three years have seen a tremendous spurt in road building. And there is even more to come as evidenced by the recently announced multi-billion dollar highway program.

With this construction comes the demand for the many types of steel and steel products that Republic makes: alloy steels for giant earth movers, high strength steel for structural parts, tubular steel for frames, pressed steel for housings, welded wire fabric and bars for reinforcing concrete, culverts for carrying off water, steel joists and roofdeck along

with steel windows and doors for fire-resistant motels and maintenance buildings, stainless steel for high style, low maintenance toll booths.

### BUT REPUBLIC CONTRIBUTES MORE THAN STEEL

Valuable chemicals derived from coal closely follow the march of the highways. Republic is a basic and one of the largest producers of benzols, toluols, tar, pyridine, crude naphthalene, xylols, heavy crude solvent and sulphate of ammonia.

# REPUBLIC



*World's Widest Range of Standard Steels*





## the Highways

These products from Republic coke ovens play an important role in highway construction from the blasting of the first rock cut to the fertilizing of the median strip and landscaping.

Which of the high-quality Republic Coal Chemicals discussed at right can you use in your product or process? Send coupon for more information.

*Visit the National Automobile Show, December 8-16, New York Coliseum.*

# STEEL

*and Steel Products*

CHEMICAL ENGINEERING—December 1956



**TRAVEL ON THE SUPER HIGHWAYS** means seeing more of rural America ... seeing how Republic Sulphate of Ammonia in mixed and blended fertilizers is restoring ruined and farmed-out lands to fruitful production. Republic supplies it in bulk or in bags.



**STOP OVERNIGHT** or spend an entire vacation at the wonderful new motels. Coal chemicals will add to both your pleasure and safety. Tar is a basis for various disinfectants. Naphthalene is used in moth repellants, fire-proofing compounds and in synthetic enamels that keep products new looking longer. Benzol is used in making plastic floor tile, in dyes for coloring cloth and fabric, in synthetics for strong and super tough suitcases.



**A MOTEL BATHROOM**, as complete as the one you have at home, reveals many uses of Republic Coal Chemicals. Benzols are used in the manufacture of many types of wearing apparel, like nylon stockings. In plastic shower curtains, synthetic-rubber bath mats, in antiseptics and aspirin, even soap. Pharmaceuticals are made from Toluols and coal-derived Pyridine. Germicides, perfumes and riboflavin of the vitamin B group are made from Xylois.



**THE CAR YOU TRAVEL IN** depends on Republic Coal Chemicals. Coal tar is used for sealing and smoothing concrete joints. Republic Benzols are used for making synthetic tires, and for nylon in the cord. Crude Heavy Solvent is used for waterproofing the top of your convertible, for stiffening leather and upholstery, for compounding rubber. Xylois, used in making paints, help provide protection and attractive appearance for your car.

**REPUBLIC STEEL CORPORATION**  
Dept. C-2706  
3116 East 45th Street • Cleveland 27, Ohio

Please send more information on:

☐ Benzols ☐ Toluols ☐ Pyridine ☐ Crude Naphthalene  
☐ Tar ☐ Xylois ☐ Heavy Crude Solvent  
☐ Sulphate of Ammonia

Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



# "Every Angle" Design Maxivision® Accuracy Bi-Metal Actuation

## Now...all 3 in one 'American' Thermometer

Only this new American Thermometer\* gives you the three features most demanded in a dial thermometer. The "Every Angle" design allows you to install this thermometer *anywhere* . . . then angle it in the direction that provides easiest reading. The anti-parallax Maxivision dial guarantees the surest, sharpest, easiest reading. Graduations are carried on a raised ring, set close to the cover glass, with an index-type, functional pointer set at the same level. The result — no perspective effect — parallax error practically eliminated. Finally, bi-metal actuation insures high sensitivity, economy, and surety of operation.

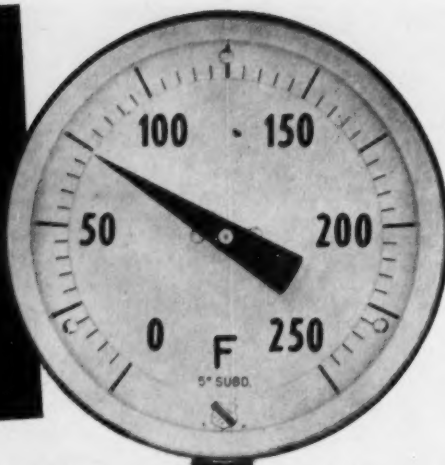
Install the new American "Every Angle" Bi-Metal Dial Thermometer anywhere — inside or out. Its climate-proof case defies any weather condition. The full use of these thermometers in any process plant makes possible temperature readings with the same ease and facility of those of a pressure gauge. Write today for complete information. Ask for Bulletin 148.

\*Pat. App. for

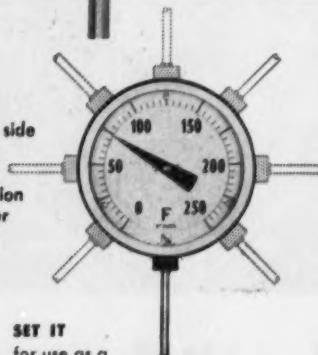
### SPECIFICATIONS

#### 5-Inch Type 5-6060 American "Every Angle" Bi-Metal Dial Thermometer

**Temperature Ranges:** From minus 80° to plus 1000° F. **Accuracy** within 1% of range. **Dial Size:** 5". **Scale** approximately 10½" long. **Bi-Metal Coil:** Low mass, with single helix close to inside wall of stem assures high sensitivity. **Silicone fluid** dampens vibration, accelerates transfer, speeds response. **Case:** Stainless steel. **Bezel:** Threaded to case. **Front:** Clear, extra-heavy glass set in channeled gasket to seal case. **Pointer:** Functional type, adjustable from front. **Stem:** Lengths — 4" to 24", 18-8 stainless steel. All joints welded. **Connection:** Fixed, ½" NPT. **Separable Sockets:** Available in all materials and sizes normally required.



**SET IT**  
for use as a side  
angle, 90°  
oblique or  
top-connection  
thermometer



**SET IT**  
for use as a  
straight-form  
thermometer



**SET IT**  
for use on oblique-  
form thermometer



**SET IT**  
for use as a standard 90°  
back-connected thermometer



**PHONE** your Industrial Supply Distributor for experienced attention to your needs. He is always ready to help you ward off costly shut-downs through fast delivery from local stocks.

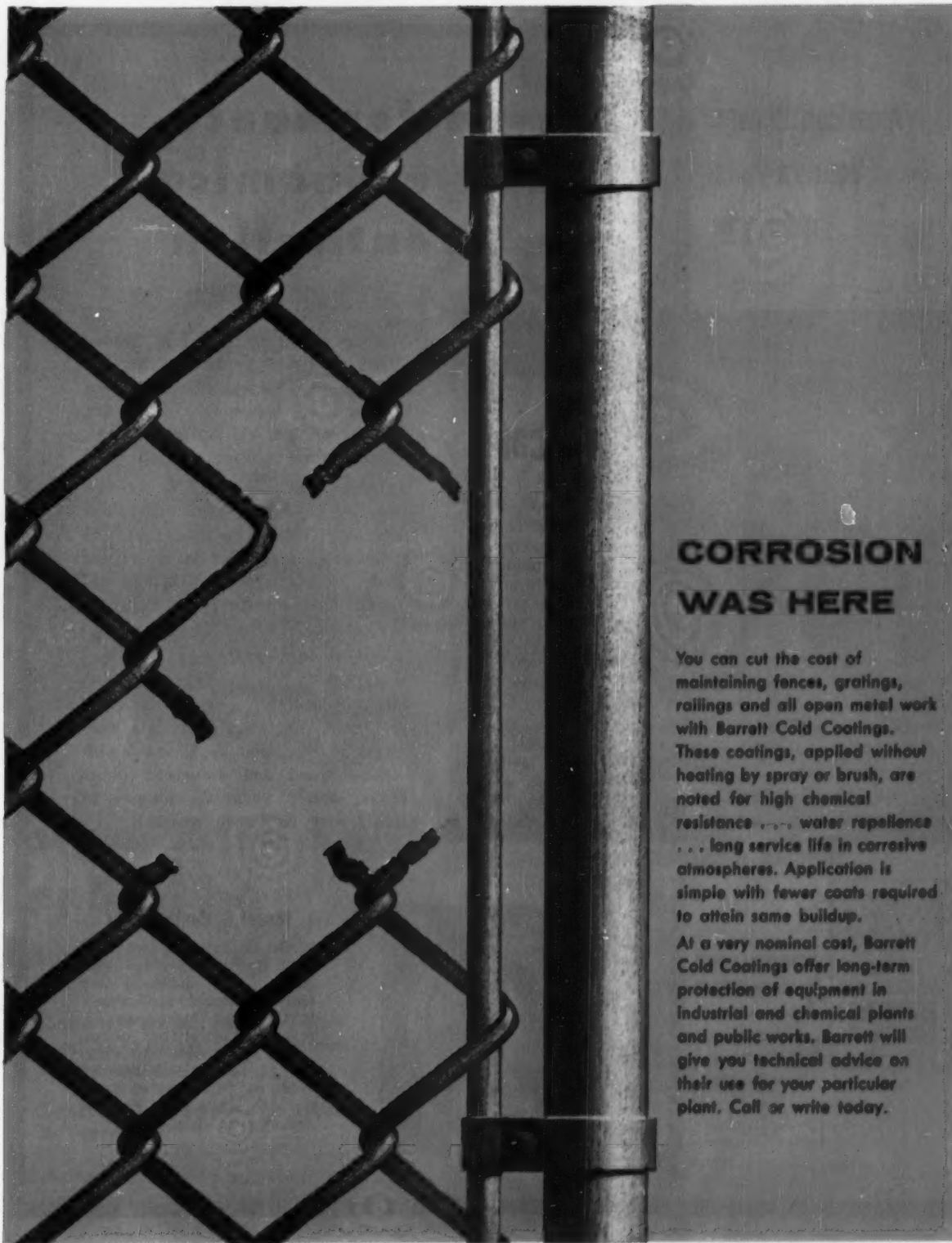
## AMERICAN INDUSTRIAL INSTRUMENTS



A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

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You can cut the cost of maintaining fences, gratings, railings and all open metal work with Barrett Cold Coatings. These coatings, applied without heating by spray or brush, are noted for high chemical resistance, water repellence . . . long service life in corrosive atmospheres. Application is simple with fewer coats required to attain same buildup.

At a very nominal cost, Barrett Cold Coatings offer long-term protection of equipment in industrial and chemical plants and public works. Barrett will give you technical advice on their use for your particular plant. Call or write today.



## PROTECTIVE COATINGS

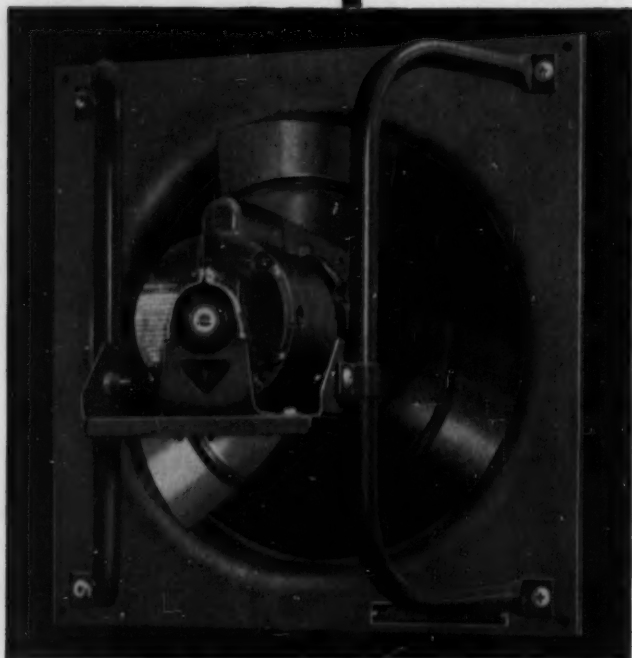
BARRETT DIVISION, Allied Chemical & Dye Corporation, 40 Rector Street, New York 6, N.Y. In Canada: The Barrett Company, Ltd., 5551 St. Hubert Street, Montreal, Que.  
OVER 100 YEARS OF EXPERIENCE





**American Blower  
Ventura Fans  
offer you**

## **top performance and economical ventilation**

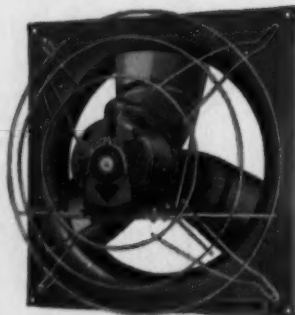
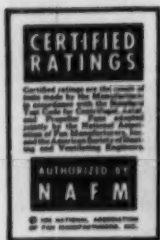


American Blower Model K Ventura Fan

You can count on American Blower Ventura Fans to do the job they are designed for, with high efficiency and a minimum of maintenance. They are built for long life and top performance. All ratings are certified.

American Blower Model K Ventura Fans are ruggedly constructed, heavy-duty propeller fans for tough industrial applications. They offer the power you need . . . when you need it, and will operate against static pressures up to  $\frac{5}{8}$ ". Request Bulletin 6514.

American Blower Ventura Fans are attractively designed, quality built, and easy to install . . . yet *competitively priced*. Ventura Fans come in a wide range of sizes and capacities — with constant-speed and two-speed direct drives, totally enclosed motors — to satisfy your exact requirements.



### **Model G Ventura Fans**

Model G, at left, is a sturdily built and attractive fan suitable for light industrial duty and commercial applications. It is especially quiet-operating, making it ideal for offices, stores, and lobbies — or wherever quiet operation is required. Write for your copy of Bulletin 6414, which gives complete performance data.

### **American Blower products serve industry**

Air Conditioning, Heating,  
Ventilating Equipment  
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Centrifugal Compressors  
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**AMERICAN 75 ANNIVERSARY BLOWER**



# NEW *Synduction* MOTOR



## Do you have an Application Requiring ...

- ... Constant speed, regardless of load or voltage, depending only on frequency.
- ... Synchronized speed for a number of motors.
- ... Adjustable speed with minimum variation at any speed setting.

## Synchronous Speed with Induction Simplicity

Allis-Chalmers new development — the *Synduction* motor — offers these characteristics at low cost — with the dependability of an induction motor. In addition to constant speed from no load to pull-out, it also offers across-the-line starting, wide range of speeds and high efficiency. It's another example of MORE motor pioneering by Allis-Chalmers.

Allis-Chalmers invites your inquiry, in the belief that many processes can be improved by the application of *Synduction* motors. Our engineers will gladly analyze your present operations to help you determine where *Synduction* motors can be applied profitably. Call your A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin, for Bulletin 51B8440.

*Synduction* is an Allis-Chalmers trademark.

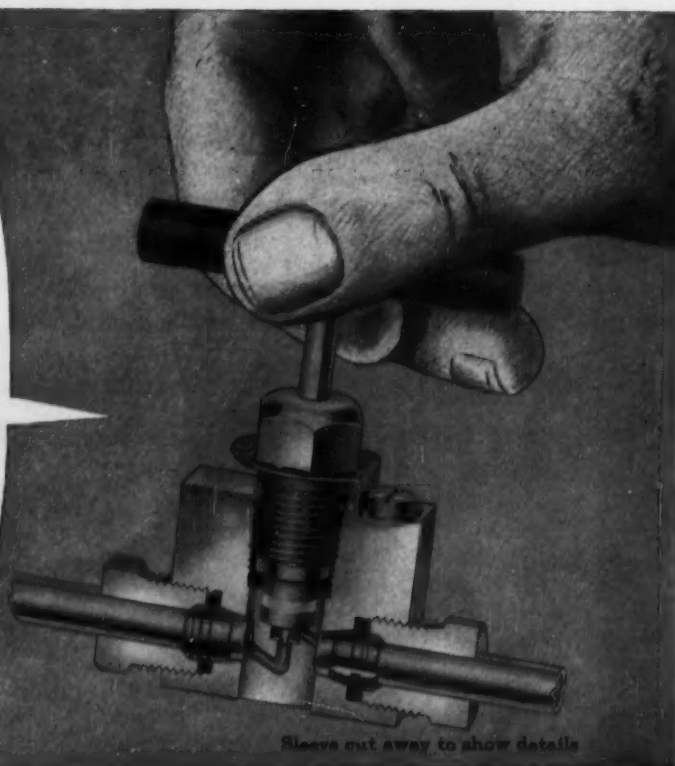


A-5115

# ALLIS-CHALMERS



For  
Fast Assembly  
To 10,000 PSI  
**AUTOCLAVE  
SPEEDVALVES  
and  
FITTINGS**



INSTALLED IN 3 STEPS



1. Cut tubing to desired length. Remove burrs.



2. Slip adapter nut and then sleeve onto the tubing.



3. Insert tubing into the valve as far as it will go. Tighten the nut.

Easy, fast tubing assemblies to 10,000 p.s.i. are now available with Autoclave Speedvalves and Fittings. The valves are quickly installed in 3 steps shown at left. No pipe threading . . . no tube reaming . . . no seal welding. Every joint is a union connection. The result: a gas-tight seal to 10,000 p.s.i. in less time, with fewer operations, at lower cost.

**SEND FOR THIS NEW BULLETIN**

A great many new items have been added to the Autoclave line of Speedvalves and Fittings. This expanded line gives you a much wider choice of standard Speedvalve equipment. New Bulletin 256 catalogs the entire line. It's yours for the asking.



**Autoclave Engineers**

2932 WEST 22nd STREET • ERIE, PENNSYLVANIA



# Why put up with down-time in Concentration Control?

## Foxboro DYNALOG<sup>\*</sup> Conductivity Systems assure continuous operation

There's no need to risk costly process interruptions caused by conductivity cells with easily-damaged electrodes . . . or with instruments requiring slidewire maintenance. Foxboro DYNALOG Conductivity Systems eliminate all this. They're designed to give continuous, troublefree service under the most rugged industrial conditions!

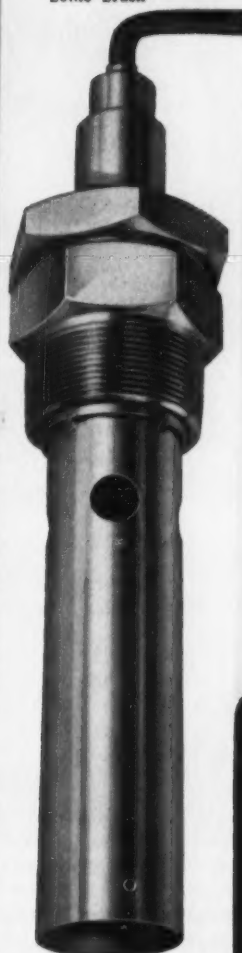
A unique, fool-proof cable seal protects all Foxboro Platinum Electrode Conductivity Cells against leakage at pressures up to 125 psig — even when completely immersed. The electrodes are imbedded in Pyrex glass tubing, flush with the inner surface. They can't clog or obstruct flow . . . cell can be safely and quickly cleaned with a bottle brush. The DYNALOG Measuring Instrument has a simple variable capacitor and positive magnetic drive for instant, stepless balancing action. It assures unequalled accuracy, sensitivity, and speed without wear. What's more, the DYNALOG's 1000-cycle voltage applied to the conductivity cell minimizes polarization effects . . . greatly reduces platinizing maintenance.

Foxboro Conductivity Systems are available for measurement or control from 0.1 micro-mho to 0.2 million micromhos with linear calibration for a practically limitless number of concentration ranges. Write for full details, The Foxboro Company, 3612 Neponset Ave., Foxboro, Mass., U.S.A.

<sup>\*</sup>Reg. U.S. Pat. Off.

### Troublefree Cell Design

- Leakproof — even at 125 psig
- Exclusive flush-mounted electrodes won't clog or obstruct flow
- Easily cleaned with bottle brush



### Immersion-type Cell with Stainless Steel Housing

All-glass immersion type also available for use under atmospheric pressure. For measurements under 10,000 micromhos, specify Foxboro Carbon Electrode Cells.

### Troublefree Instrument Design

- No slidewire maintenance
- No motor maintenance
- 1000 cycle cell excitation voltage



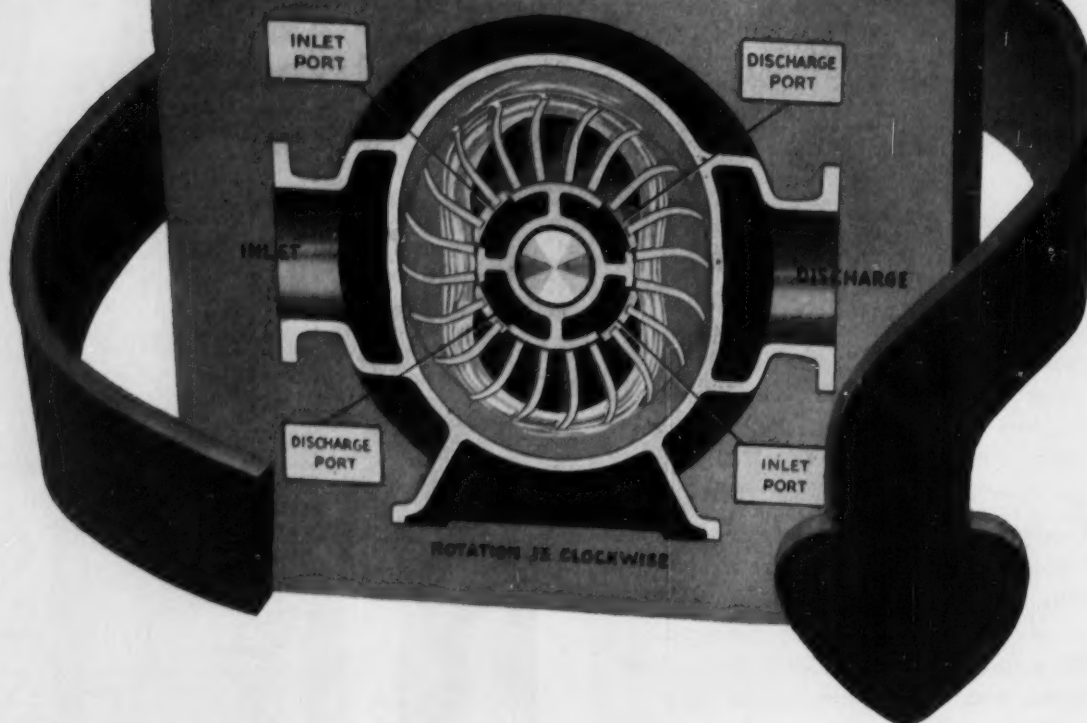
# FOXBORO

Reg. U.S. Pat. Off.

CONDUCTIVITY MEASUREMENT AND CONTROL



**Nash Instrument Air Compressors  
deliver only clean air, free from  
oil or dust, and without filters**



## *Here is Why!*

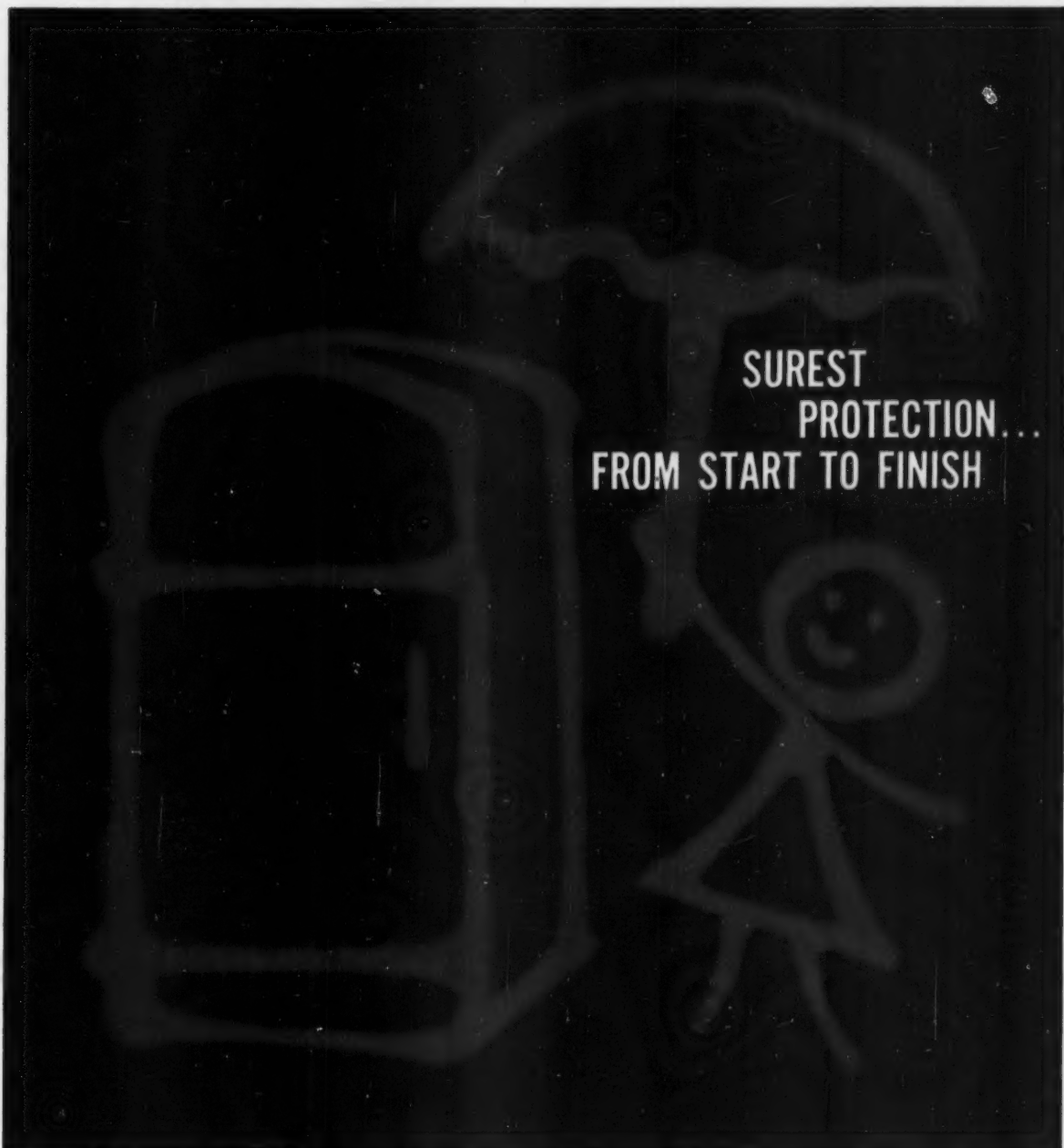
You can dispense with oil filters and dust filters when you install ©Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

©Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters.  
No dust filters.  
No internal lubrication to contaminate air handled.  
No internal wearing parts.  
No valves, pistons, or vanes.  
Non-pulsating pressure.  
Original performance constant over a long pump life.  
Low maintenance cost.

**NASH ENGINEERING COMPANY**  
395 WILSON, SO. NORWALK, CONN.





SUREST  
PROTECTION...  
FROM START TO FINISH

Like all Esso Petroleum Solvents, Solvesso 100 is unsurpassed in its class for uniformity and purity. It assures top performance from force-dry finishes on countless home appliances and other products. Solvesso 100 is the perfect companion for the other outstanding ingredients used to assure the best results in all protective finishes.

The entire Solvesso group of aromatic solvents sets performance standards *throughout* the paint and surface coatings industry. Besides top quality, these products offer a most reliable source of supply and *immediate* delivery from key distribution points with Esso's excellent customer service and modern handling methods. For the surest protection from start to finish, *always* specify Esso Petroleum Solvents. Write, wire or telephone today! Esso Standard Oil Company, 15 West 51st St., N. Y. 19, N. Y.

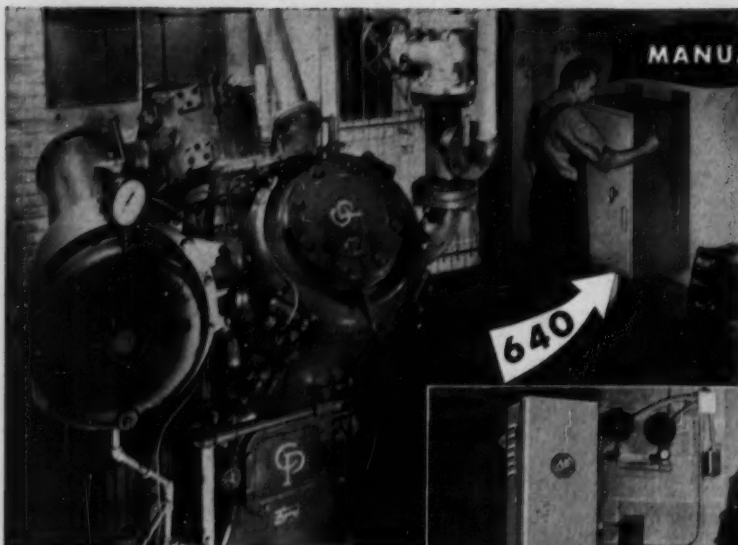
# SOLVESSO 100

SOLVESSO TOLUOL • SOLVESSO XYLOL • SOLVESSO 100 • SOLVESSO 150  
High-Quality Aromatic Solvents covering the full range of industrial needs



PETROLEUM SOLVENTS

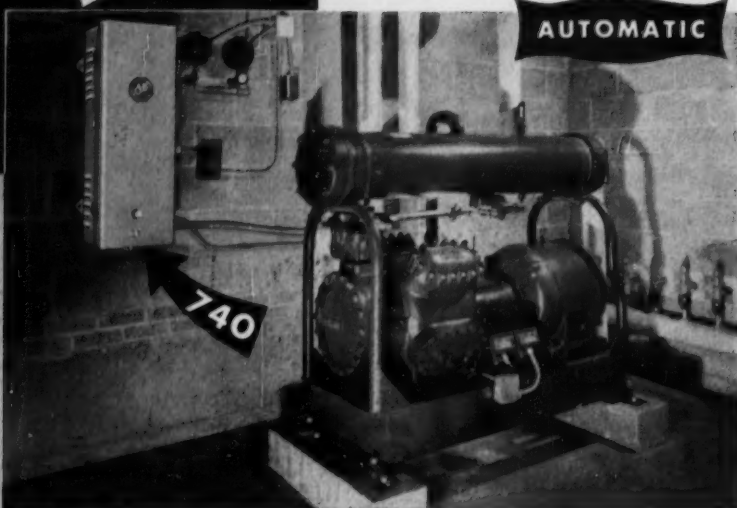




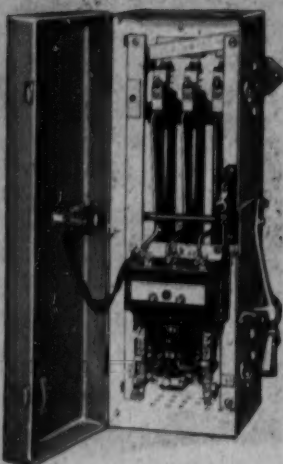
## MANUAL

Large CP compressor equipped with Allen-Bradley Bulletin 640 resistance starter. Motor is speeded up by slowly raising starter lever. No current inrush—velvet smooth start.

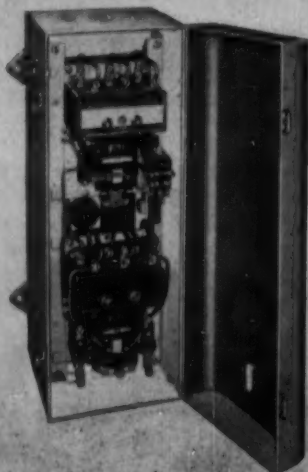
Trane air-conditioning compressor equipped with Allen-Bradley Bulletin 740 automatic resistance starter. Two-step starter smooths out current inrush—prevents lamp flicker.



## AUTOMATIC



BULLETIN 640 manual starter with cabinet open to show the three starting compression resistors.



BULLETIN 740 automatic resistance starter. Starting resistors are located behind the two contactors.

# EASY ON THE LINE... EASY ON THE MOTOR

No jerks or jolts—Satisfies the power company

Allen-Bradley compression resistance starters afford a neat solution for smoothing out the starting current and torque of heavily loaded squirrel cage motors. Graphite disc resistors, available only in Allen-Bradley compression starters, control the starting current and torque with velvet smoothness . . . and without lamp flicker.

These jerkless starters prevent damage or undue stress on belts, chain drives, or gears. They are equipped with dependable and accurate overload relays.

Available for squirrel cage motors up to 200 hp, 220-440-550 v. Send for Bulletins 640 and 740, today.

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SOLENOID MOTOR CONTROL

QUALITY



# NEW ALCOA ABRASIVE ALUMINUM TREAD PLATE MEANS SAFE FOOTING!



**slip-proof** under oil or water films on inclines up to 30°

Now you can eliminate lost man-hours from slip-slide accidents on oil- or water-covered walkways, ramps and ladders. New ALCOA® Abrasive Tread Plate is slip-proof! Made of a tough aluminum alloy, it has slip-proof aluminum oxide rolled right into its surface. That means safe, sure footing even when this new tread plate is covered with oil or water and inclined at angles up to 30°.

Like all aluminum products, new ALCOA Abrasive Tread Plate cannot rust . . . won't corrode in atmospheres normally corrosive to most metals. One-third the weight of steel, it's light and easy to handle. It's easy to fabricate and comes in standard sizes and thicknesses.

If slip-slide accidents are a problem in *your* plant,

solve it once-and-for-all with ALCOA Abrasive Tread Plate. Use it for all your walkways, ramps and ladder treads! See your nearby ALCOA distributor or use the handy coupon for full details.

**Mail this for new free book on  
Alcoa Abrasive Aluminum Tread Plate**

Aluminum Company of America  
903-M Alcoa Building, Pittsburgh 19, Pa.

Gentlemen:

Please send me your new 8-page booklet, *Alcoa Abrasive Tread Plate*.

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ALTERNATE SUNDAY EVENINGS







use steam efficiently, economically—choose the trap with . . .

## just one moving part

...for easy maintenance

After all, a steam trap *should* be simple. Its job of discharging condensate and air from steam lines and equipment, is a simple one. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

With Nicholson steam traps there's just one moving part. Nothing to go wrong. But with all their simplicity, Nicholson traps have the greatest capacity of any trap their size. Plenty of other important features, too, and it'll be well worth your while to check them.

- Powerful valve action
- Tight, positive shutoff
- No dribbling, no steam waste
- Each unit service tested

Specify Nicholson, and be sure.



Write today for new  
Bulletin 10-55

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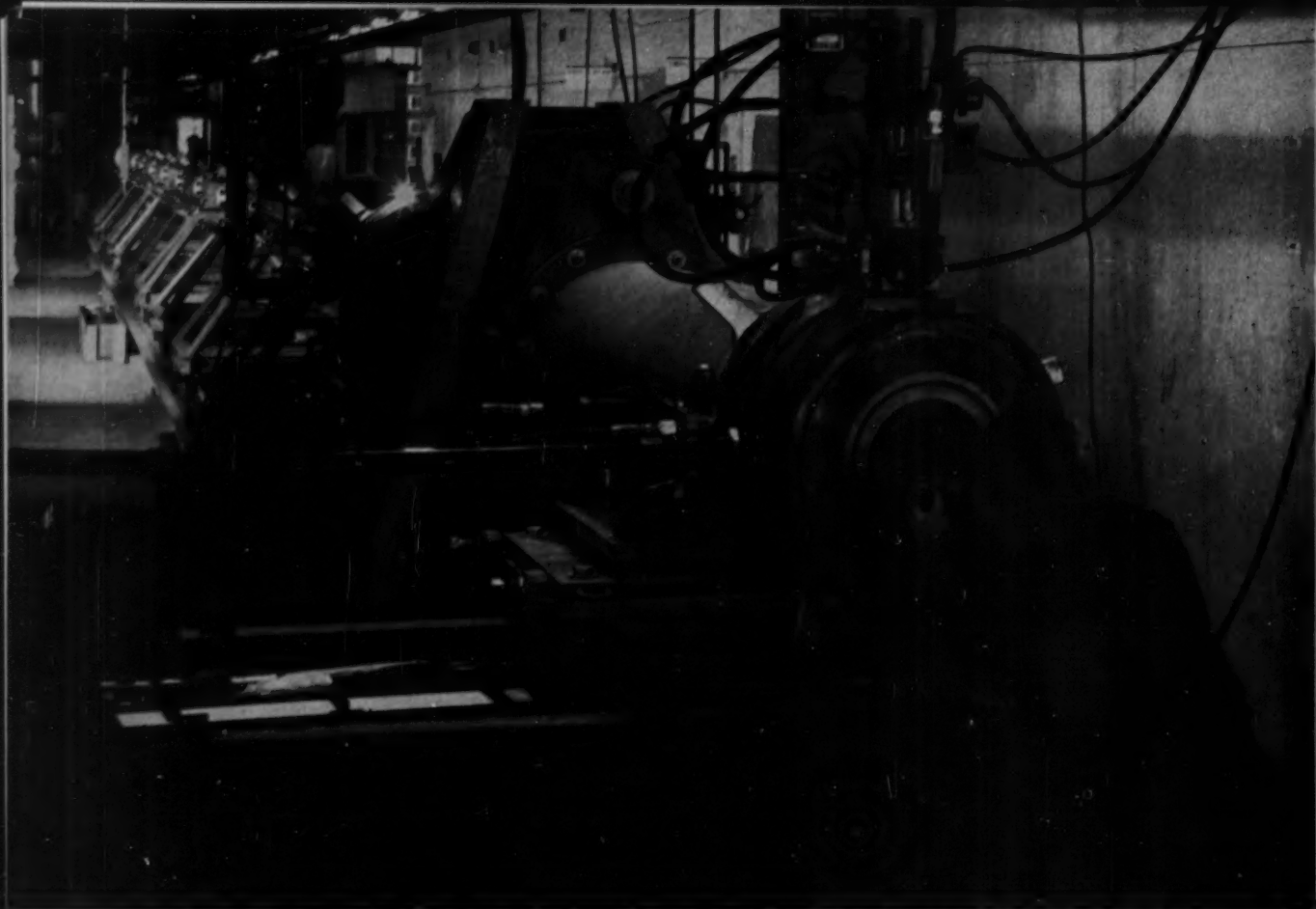
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When a boy asks this question, a "yes" may lead to his becoming a key man in a key profession. As an engineer, he will be doing some of the most essential work in his generation... designing a refinery, planning a power station, laying a pipeline. Our country needs twice the number of engineers it now has.

*Bechtel, in the mainstream of engineering, technological and industrial developments, has good reason to know that as great as are today's opportunities for the technically trained man, tomorrow's will be greater.*

*America is the winner every time engineering gains another recruit.*





*A technician checks the ALCOPLATED interior of the giant shock tube's driver section.*

## **ALCOPLATED DRIVER SIMULATES 18,000 MPH, 15,000 F**

**Chemically Deposited Nickel Plate Serves Under Extremely High Temperatures and Pressures; Corrosion and Erosion Resistance Help Avco Researchers Reach Some of the Highest Speeds Ever Attained.**

Inside the world's largest hypersonic shock tube, a gas dynamics research device developed by Avco Manufacturing Corporation for the U. S. Air Force, speeds to 18,000 mph and split-second temperatures as high as 15,000 F are reached. Pressurized gases, built up in the tube's driver section, burst a metal plate to form a shock wave simulating travel at 25 times the speed of sound.

Using ALCOPLATE\* in the internal bore of the driver section gives Avco Research and Advanced Development Engineers the corrosion resistance and hardness qualities necessary to withstand tremendous internal pressures. In the driver, as in all cases, ALCO's quality controlled application of ALCOPLATE meets the highest customer requirements and produces uniform, adhesive plating.

Chemically deposited nickel-phosphorus ALCOPLATE, providing protection from erosion and corrosion in this unusual application, can mean savings and process equipment protection in normal industrial applications, too. Inquire at the nearest ALCO Sales Office or write to P. O. Box 1065, Schenectady 1, New York for further information.

\*ALCOPLATE — Trade-mark registration applied for. An application of "Kanigen" a mark identifying the chemical deposition of high-nickel, low-phosphorus alloy by General American Transportation Corporation and its licensees and the coating resulting therefrom — on license from General American Transportation Corporation.

**ALCO**

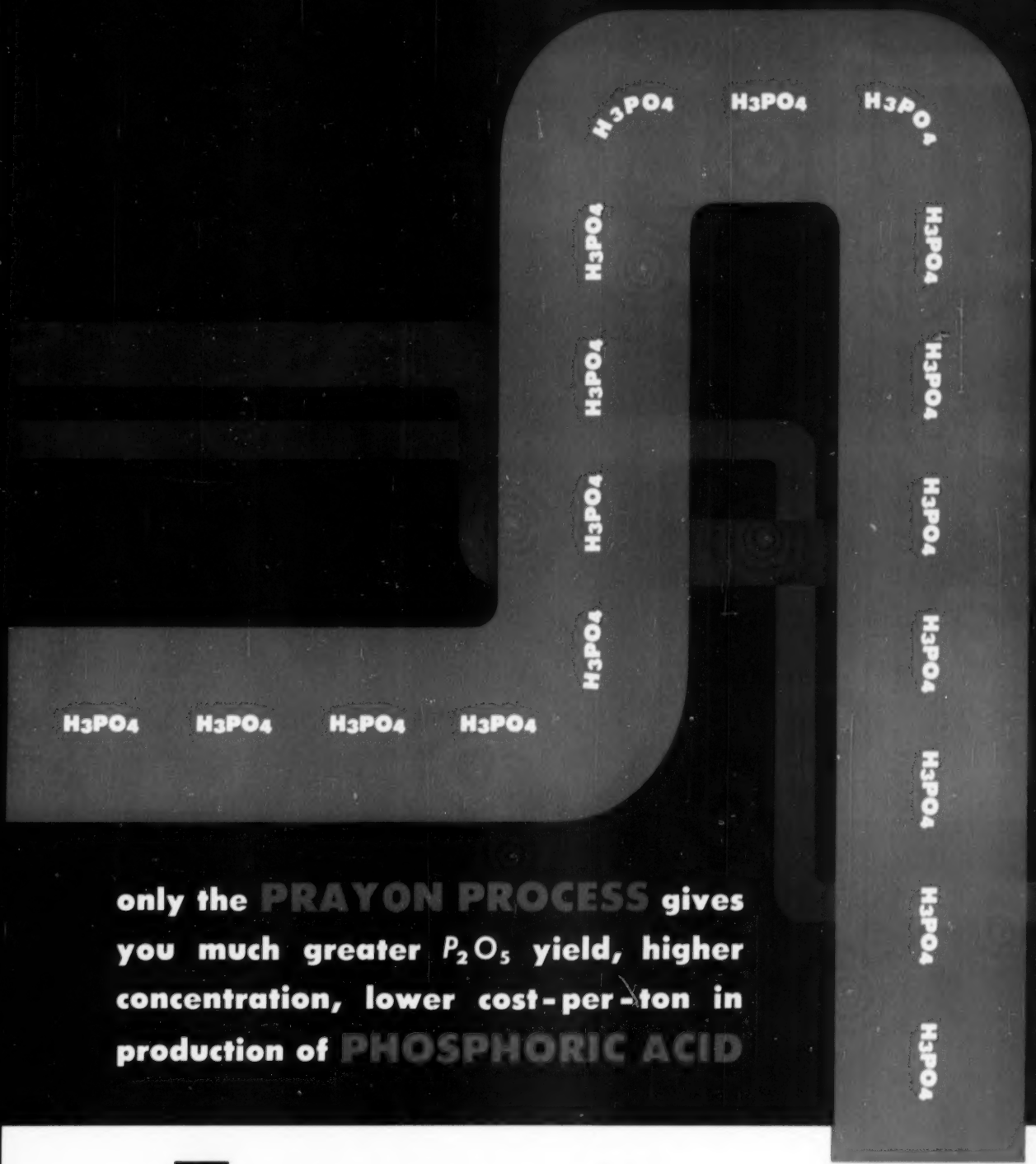
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### The proven partner for PVC Piping

For the finest valving in plastic piping systems—specify the valve with experience “built-in”—The Hills-McCanna Diaphragm Valve made of PVC.

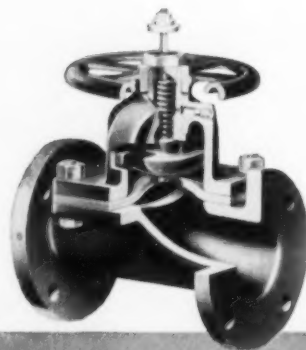
**ONLY Hills-McCanna Plastic Valves offer all these features—**

- Complete chemical resistance of unmodified PVC.
- Rugged body construction with heavy wall sections and embedded reinforcing members.
- Positive valve closure with exclusive sealing bead diaphragm.
- Simple, cost-saving in-line maintenance.
- 25 years of diaphragm valve manufacturing and application experience.
- More than 10 years of research and manufacturing experience on plastic valves alone.

PVC is just one of several plastic body materials offered by Hills-McCanna. Also available are bodies of polyethylene, Saran and Uscolite. Diaphragm materials include rubber, neoprene, Hycar, Tygon, Compar, polyethylene, Kel-F and Teflon. Size range from  $\frac{1}{2}$ " through 2". Sold and serviced by Hills-McCanna representatives coast to coast and by leading distributors of plastic pipe. For further information request Catalog No. 100.

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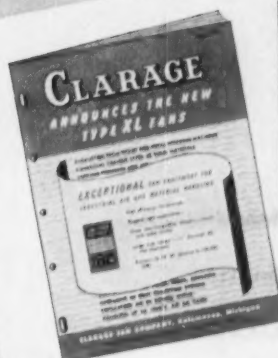
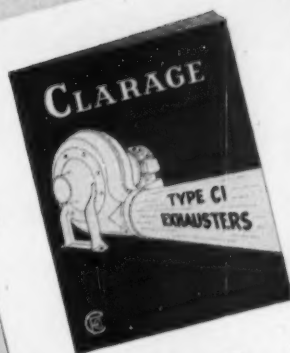
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Detailed information on  
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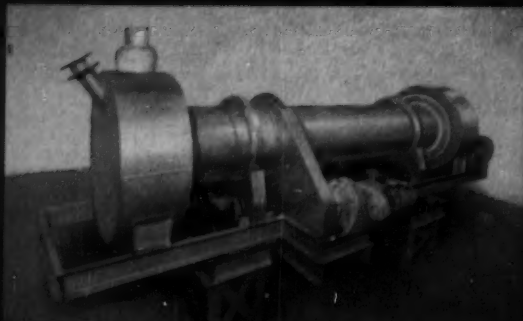
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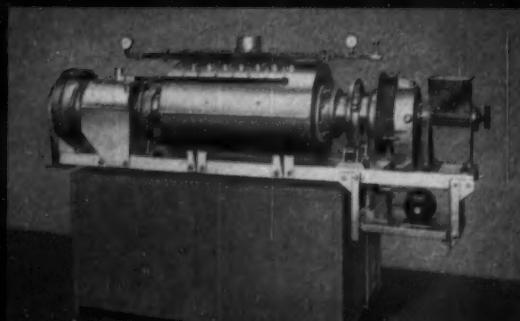
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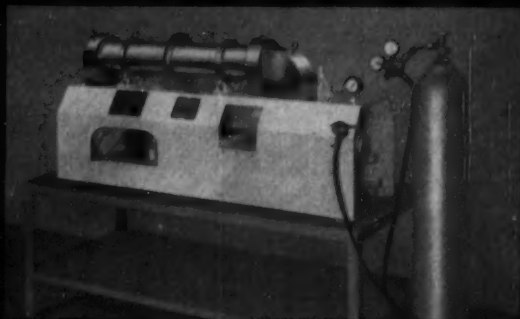


Experimental Size Rotary Kiln.



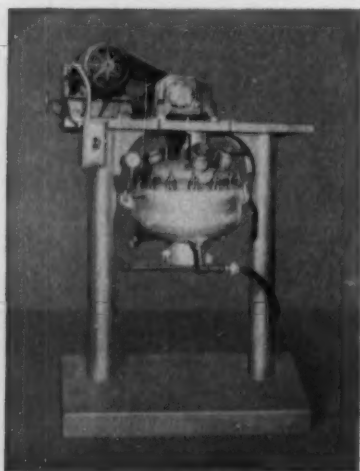
Rotary Combination Calciner and Cooler.

# BARTLETT B-SNOW *Laboratory and Experimental* UNITS



Gas-Fired Experimental Rotary Dryer.

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Pot Type Batch Dryer with Rotary Sweep.

Check carefully before you recommend construction of a costly semi-works or full plant operation. Determine accurately — by actual runs in laboratory size equipment — the heat sensitivity, permissible temperatures, entrainment losses, desirable velocities, balling, sticking, cooling and all other chemical and physical aspects of your product. Our complete line of laboratory size experimental equipment includes a continuous combination calciner-cooler; steam heated and gas-fired rotary dryers; pot type batch dryer with rotating sweep; and rotary kiln. Pre-testing can save you thousands of dollars!

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(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

*Now...for low steam consumption —*  
**COPPUS TURBINES** *can be furnished*  
*with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp

requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.

- A larger number of steam nozzles, controlled individually by manually operated valves.

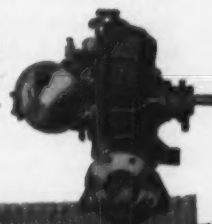
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.

- Replaceable cartridge type bearing housings.

- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

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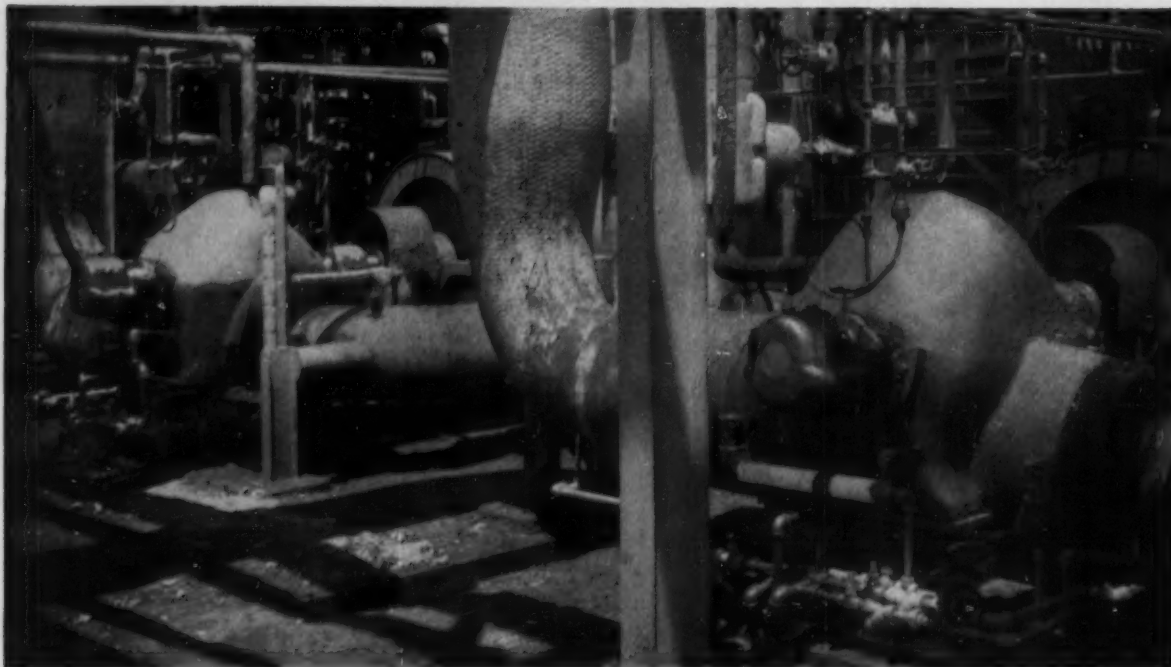


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## **PUMPS** Solve a Chemical Industry Problem



# **All-Stainless-Steel Pumps Handle Hot Corrosive Liquids**

Manufactured on duty-specifications from the customer, these Allis-Chalmers Type SG stainless steel pumps are successfully handling a highly corrosive mixture of carbonate, urea, oil, and water at 260 F.

This is another example of the way Allis-Chalmers serves the chemical industry with a wide range of types of pumps in all sizes. These versatile, high efficiency Allis-Chalmers pumps are available in many special materials to meet specific application requirements.

**For full information** on how Allis-Chalmers can help you reduce costs, contact your local Allis-Chalmers district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



A-4983

# **ALLIS-CHALMERS**

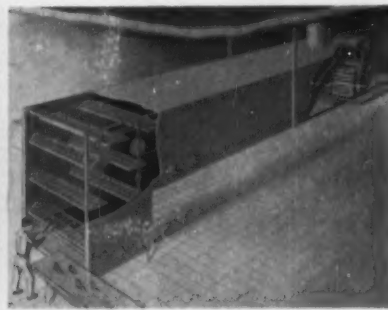
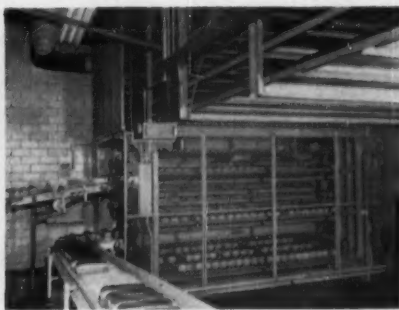
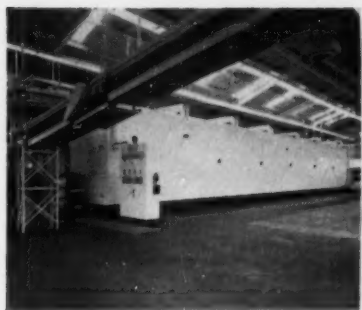
**You Get MORE  
when you Get  
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**You can benefit** from Allis-Chalmers years of experience in pump manufacturing for all industries. The design and engineering skill resulting from this experience is at your service — you get special construction pumps that give top performance and low operating costs.

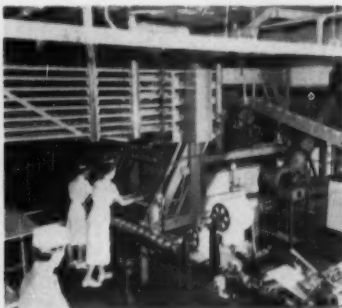
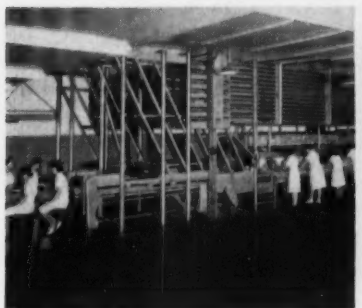
Allis-Chalmers industry-experienced engineers will help you select exactly the Allis-Chalmers pump to meet your needs, and Allis-Chalmers can furnish a complete pump unit—pump, motor, and control.



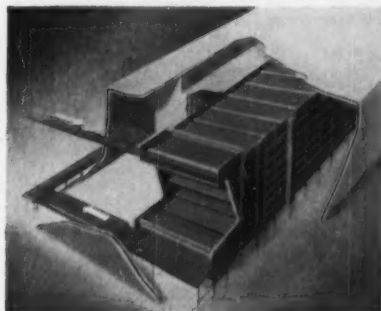
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*Proven results: Improved Quality — Space Saved — Costs Cut — Production Increased*

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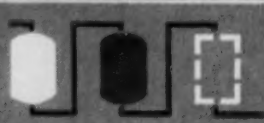




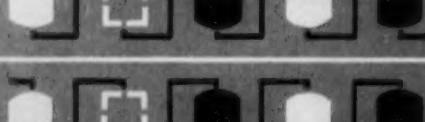



Sales Engineering Offices: Chicago, Ill., and San Francisco, Calif.





# 9 ways to demineralize water

(BY ION EXCHANGE)

KEY:	 Hydrogen Cation Unit - Removes metallic cations such as calcium, magnesium, sodium. Regenerated with sodium for simple water softening.	 Weakly Basic Anion Unit - Removes strongly ionized acids such as sulfuric, hydrochloric, nitric.	 Strongly Basic Anion Unit - Removes strongly ionized acids, also weakly ionized acids such as silicic and carbonic.	 Mixed Bed Unit - Contains both Hydrogen Cation and Strongly Basic Anion Exchangers, intimately mixed.	 Degasifier - Optional. Reduces load on Strongly Basic Anion Exchanger by removing free CO <sub>2</sub> brought in by raw water or developed in cation unit.
A			Effluent Conductivity - 10 to 20 micromhos (no silica reduction)		Uses low-cost anion exchanger and anion regenerant (soda ash). Typical use—removing soluble salts from water for ceramic mixes and slips or from rinse waters used before painting, mirror silvering, etc.
B			Effluent Conductivity—same as A. Silica content - 0.02 to 0.10 ppm.		Used for treating feedwater for boilers in general range of 600 to 1400 psi. Also (without degasifier) for removing impurities from plating baths and recovering chromate from plating rinses.
C			Same effluent as B.		For raw water with high sulfate and chloride content. Low-cost Weakly Basic Anion Exchanger removes major portion of electrolyte load. Countercurrent regeneration of anion units reduces operating costs.
D			Effluent Conductivity - 1 to 2 micromhos. Silica same as B.		For same type of raw water as C. Countercurrent regeneration of both cation and anion units cuts operation costs.
E			Effluent Conductivity - 1 to 2 micromhos. Silica same as B.		For waters where alkalinity is a major part of the anion content. Polishing units require infrequent regeneration. Produces, at low cost, low-solids feedwater suitable for high pressure boilers (over 1400 psi).
F			Same effluent as E.		High flexibility of operation. Can operate in parallel for peak flows. Can maintain service flow during regeneration of either pair of units.
G			Effluent Conductivity—less than 1 micromhos. Silica same as B.		Produces effluent of extremely high quality. Suitable for "super critical" pressure boilers and atomic reactors. (Initial and operating costs are usually higher than for separate anion and cation units.)
H			Same effluent as G.		For raw water with high sulfate and chloride content. Two-step demineralizer reduces load on Mixed Bed unit, cuts operating cost. (Strongly Basic Anion Exchanger is used in place of Weakly Basic where raw water has high silica and alkalinity.)
I			Same effluent as G.		Recommended where alkalinity of raw water is high. Cation unit and Degasifier reduce load on Mixed Bed unit, cut operating costs.

All of the above systems, with equipment and resins made by Permutit, are in commercial use. Other combinations are possible—also use of special ion exchangers such as PERMUTIT SK for separating uranium oxide from other metallic oxides in ore.

Most of these systems (C and higher) are used almost exclusively for demin-

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If you have a problem ion exchange might solve, we'll be glad to study it with you and bring you the benefits of this experience. Address: The Permutit Company, Dept. CE-12, 330 West 42nd New York 36, N. Y.

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rhymes with "compute it"

ION EXCHANGE for Water Conditioning  
Chemical Processing • Industrial Waste Treatment



# STAINLESS

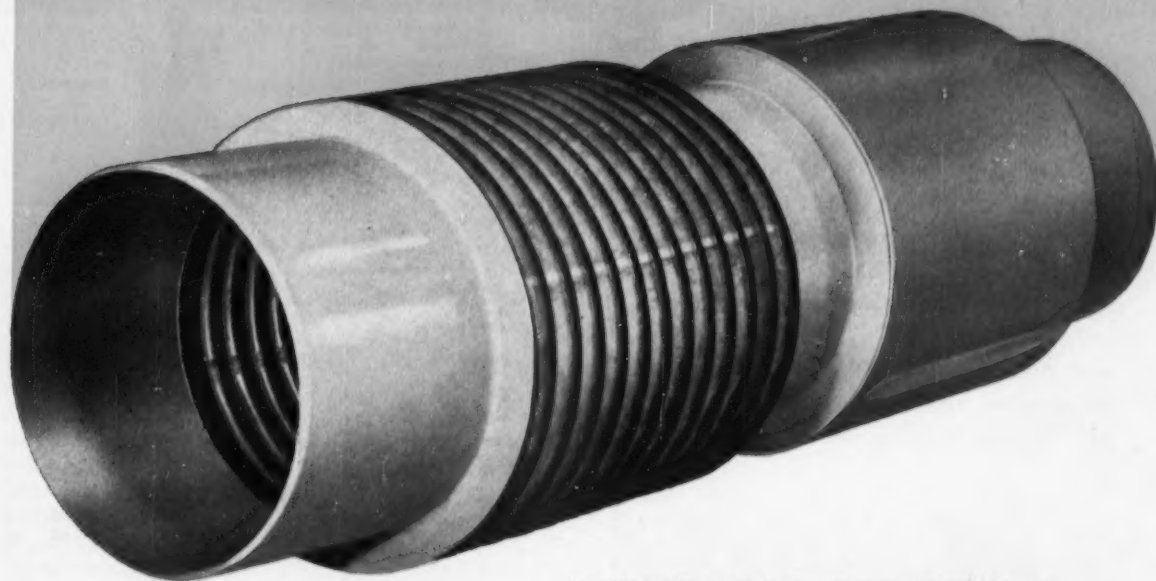
fights corrosion, temperature  
and fatigue  
*in this*  
double  
expansion  
joint

This is a two-element expansion joint used in power, heating, industrial and process applications. Its job is control of thermal expansion in pipelines. And it's constantly exposed to the triple-hazards of corrosion, high pressures and temperatures.

These are good reasons why its maker, Badger Mfg. Co., Cambridge, Mass., found Crucible type 321 stainless steel sheet their best choice. For Crucible stainless is easy to fabricate, has good physical properties, and is exceptionally resistant to corrosion and heat.

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The Oliver Building, Mellon Square,  
Pittsburgh 22, Pa.*



Crucible worked with the manufacturer, Badger Mfg. Co., in the development of this new-type stainless steel expansion joint. Made from a single tube, its maximum diameter approximates that of ordinary flanged fittings.

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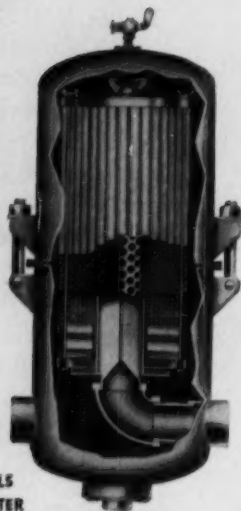
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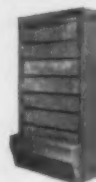
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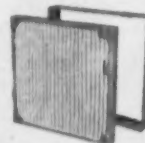
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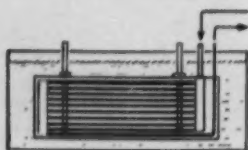
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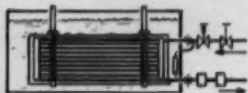
# now HEAT TRANSFER SKETCH BOOK

Valuable ideas based on actual installations of Tranter Platecoil heat transfer units are contained in an informative new bulletin on Platecoil construction, installation and cost-saving advantages. Featured prominently in the booklet are 14 sketches for as many uses of Platecoil in a complete variety of tanks — with a brief description of each installation. Platecoil units can be used in many ways and in many industries. Send today for your free copy of Bulletin P-61, and discover how you can cut heat transfer costs all over the plant with Tranter Platecoil.

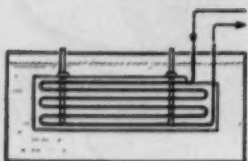
***shows how to cut costs  
all over the plant!***



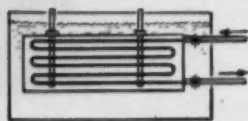
OPEN PROCESS HEATING TANK



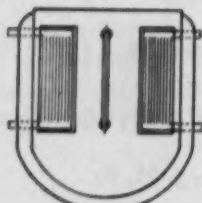
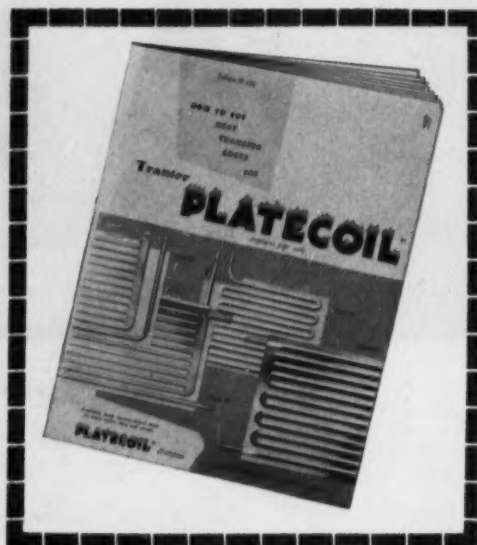
OPEN PROCESS HEATING TANK



OPEN PROCESS COOLING TANK



OPEN PROCESS COOLING TANK



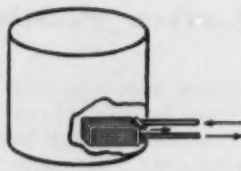
JACKETED TANK



AGITATED TANK



AGITATED TANK



CLOSED TANK, CLOSED MOUNTING



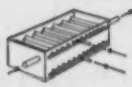
CLOSED TANK, CLOSED MOUNTING



CLOSED TANK,  
EXTERNAL MOUNTING



CLOSED TANK,  
EXTERNAL MOUNTING



WASTE-HEAT  
RECOVERY



OVEN AND FURNACE



HEAT SCREEN

You'll find our Catalog in Sweet's Plant Engineering File.



**PLATECOIL®** division

TRANter Manufacturing, Inc. ~ LANSING 4, MICHIGAN



# CHOICE of CONTACTORS

to meet your specific needs

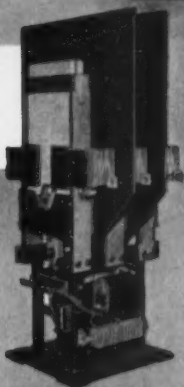
Allis-Chalmers Type H Starters may be equipped with either air-break or oil-immersed contactors — installed in the same sized space.

## ALLIS-CHALMERS Type H Starters

FOR 2300 TO 5000  
VOLT MOTORS

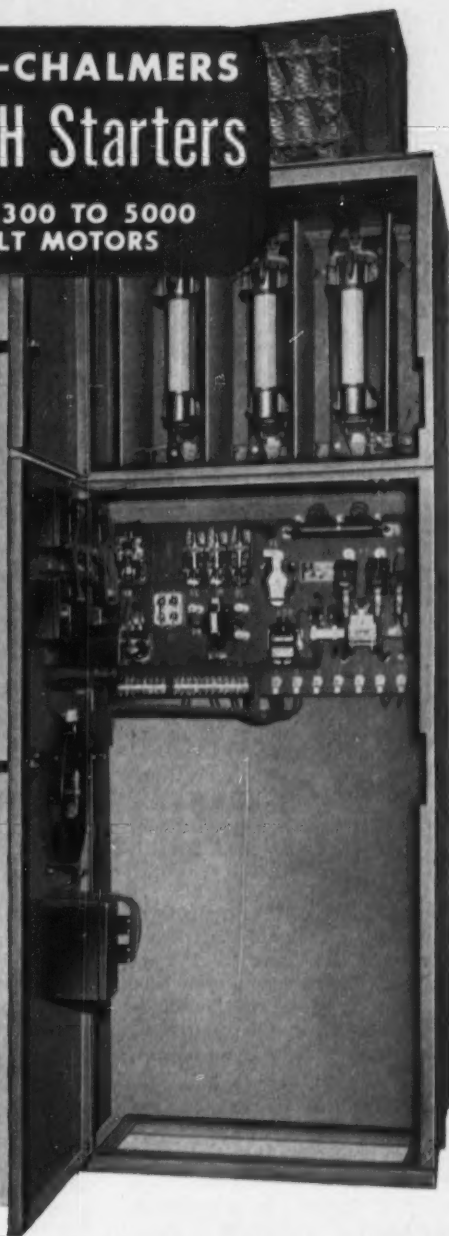
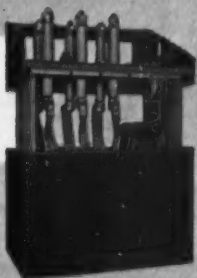
### AIR

Designed for top performance on the rough-tough jobs. Advantage of contacts operating in air include long contact life, reduced fire hazard, easy maintenance. Double-break contacts, vertical action and dual blowouts provide long, dependable operation. Design simplicity makes contactor particularly adaptable for applications requiring frequent starting, inching, reversing, or dynamic braking.



### OIL

Meets operating demands of semi-hazardous locations. Contactor operates under oil to prevent sparks from igniting atmosphere and to protect mechanism from corrosion. Contactor is time-proved clapper type. Self-cleaning, rolling-wiping action extends contact life. Self-aligning E-type magnet provides perfect armature seating... quiet, maintenance-free operation.



### YOU GET MORE...

Allis-Chalmers offers help on specific control application problems. Call your Allis-Chalmers representative. His recommendations are backed by Allis-Chalmers engineering departments... by the experience gained

in solving thousands of control problems... by complete research and testing facilities.

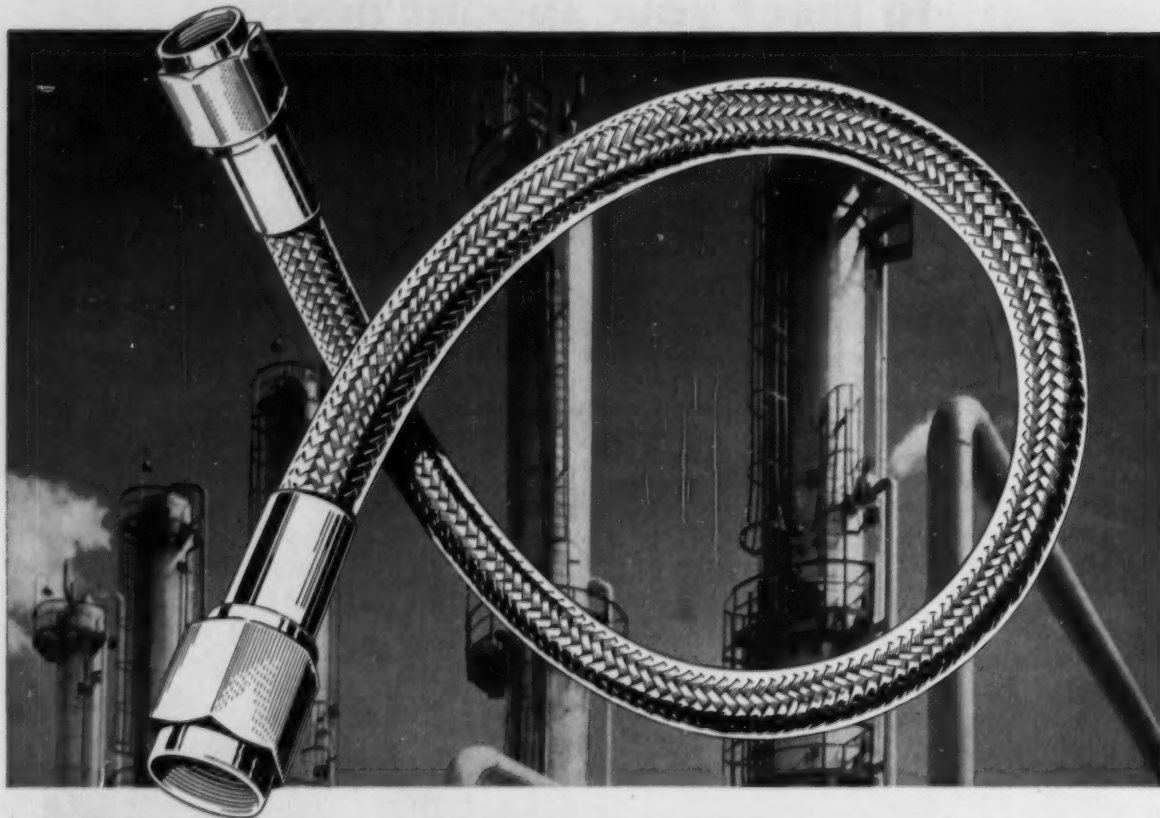
For complete information on the Type H starter, write for Bulletin 14B6410B — Allis-Chalmers, General Products Div., Milwaukee 1, Wis.

# ALLIS-CHALMERS

A-4976



# NOW AVAILABLE for chemical applications



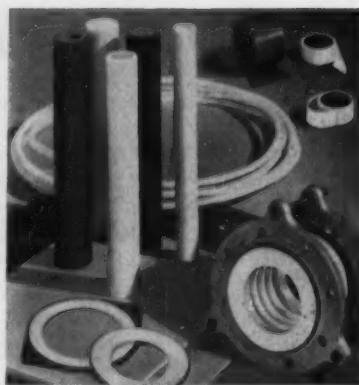
## R/M FLEXIBLE THIN-WALL *Teflon* HOSE

Working with "Teflon" requires knowledge and skills that only experience can provide. Raybestos-Manhattan's research and testing laboratories have been actively engaged in developing the vast potentials of this remarkable material ever since it first became available.

Now out of these laboratories comes R/M Flexible Thin-Wall "Teflon" hose—wire braided or rubber covered—for handling corrosive fluids. It is a tubing of tremendous promise. It shows no reaction whatsoever to chemicals. It has great flexibility, and does not expand, contract or fatigue. It

offers extreme resistance to high temperatures. It is produced in a wide range of inside diameters and wall thicknesses. Write us for detailed information and feel free to call on us for help in solving problems involving such tubing.

Other R/M "Teflon" products for the chemical industry include: rods, sheets, tubes and tape; centerless ground rods held to very close tolerances; stress-relieved molded rods and tubes; gaskets; expansion joints and flexible couplings; Raylon—R/M trade name for mechanical grade "Teflon"—has many characteristics of virgin "Teflon." For complete details call or write R/M. <sup>®</sup>Du Pont trademark



## RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels  
Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Bowling Balls



# More Precise Design Calculations with M. W. Kellogg's New, Super-Speed

# ELECTRONIC COMPUTER

HEAT EXCHANGER		
DESIGN TYPE	25614 00000	200 00003
ARRANGEMENT	SERIES PA	00000
SURFACE TOTAL PER SHELL	2 79 55760	10 9 576
TOTAL FLUID 1000 LBS	40 00000	1 000
SHELL LIQUID	87620	6
TEMP VISCOSITY FCS A	3130 01306	53 0 007
TEMP VISCOSITY FCS B	300 01102	53 0 007
TEMPERATURE HOT	000 00000	0 000
TEMPERATURE COLD	30 00000	6 000
TUBE PASSES PER SHELL	00000	2 00000
PRESS DROP ALLOW PSI	10 00000	15 00000
DESIGN CALCULATIONS	00000	10 00000
FOUR REACTORS & TANKS COMPTER	00000	00000
DUTY MM HRS TO TD	1 30000	64713
TOTAL REACTOR SERVICE CALCD	01430	01163
DESIGN REACTOR PSI	15 00000	30 00000
TUBE NUMBER & LENGTH FT	21 42070	2 00000
SHELL ID & BANG PATCH	2 25000	61250
NOZZLE SIZE & SHELL IN OUT	00000	00000
NOZZLE SIZE IN	00000	00000
CORROSION ALLOWANCE IN	12500	12500
COMPUTATION RESULTS	00000	00000

The partial tabulation above shows how computer presents results. The computer itself is shown at the right.

The latest addition to The M. W. Kellogg Company's facilities for engineering heat-pressure process equipment is a new, large magnetic drum digital computer. It can execute 500 arithmetical operations per second; conservatively can solve 40 simultaneous equations in 30 minutes; and has a memory capacity of over 4000 ten-digit words.

This new computer enables M. W. Kellogg's engineering staff to undertake a far greater number

of precise calculations in less time than ever before and, as a result, to determine the optimum designs for customers in minimum time. For example, complete calculations for a liquid to liquid heat exchanger, which formerly took 10 to 15 hours, now can be done in about 15 minutes.

Electronic computation is an important supplement to the productivity of Kellogg's heat transfer engineers and permits them more time for evaluating results and im-



proving designs. We welcome the opportunity to demonstrate what these aspects of Kellogg's "built-in engineer" can contribute to your requirements.

**Fabricated Products Division THE M. W. KELLOGG COMPANY 711 Third Avenue, New York 17, N. Y.**

A SUBSIDIARY OF PULLMAN INCORPORATED

The Canadian Kellogg Company Limited, Toronto • Kellogg International Corporation, London • Societe Kellogg, Paris  
Kellogg Pan American Corporation, New York • Companhia Kellogg Brasileira, Rio de Janeiro • Compania Kellogg de Venezuela, Caracas



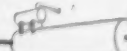
HEAT TRANSFER  
EQUIPMENT



PROCESS  
PIPING



KNOCKDOWN  
VESSELS



TANKS AND  
REACTORS



PRESSURE  
VESSELS





## Making control look easy in automatic proportioning

These Richardson Scale Company technicians have an important job . . . checking out a remote control panel for a Richardson Select-O-Weigh Proportioning System. Large units or small, like this one—all get the same thorough pre-shipment test. Here accurate proportioning is made to look easy—just a matter of setting a dial. But there's *more* to automatic control than a control panel . . . much more!

Richardson engineers know that accurate control of material flow and exact proportioning *depend as much on precise design of storage bin, feeder, and scale* as they do on electronic perfection. The storage bin must be properly sloped to prevent bridging or flushing; the feeder must provide

positive, consistent material movement; the scale must weigh accurately to within superfine tolerances. And all must be integrated to insure a dependable, correlated performance—without human supervision all along the way!

The value to you of a Richardson Select-O-Weigh system lies in the quality of your finished product . . . both now and for year after profitable year. Protection of that quality is worth greater consideration than initial cost (and Richardson costs less on a value per dollar basis). It is worth your thorough analysis of the proportioning system itself! Richardson invites you to analyze—and specify—Select-O-Weigh. Send for Bulletin 0351 for more information.

When it comes to proportioning, you're in good company when you come to Richardson. Look at some of the others who now have proportioning by Richardson:

The Firestone Tire & Rubber Company • General Foods Corp.  
General Electric Company • U. S. Bureau of Mines  
Reynolds Metals Company • American Rice Milling Co., Inc.  
Union Carbide & Carbon Corporation • Ford Motor Co. •  
Fleischmann Distilling Corp. • The Flintkote Company  
Johnson & Johnson • National Distillers Products Corp.  
Owens-Illinois Glass Co. • Pittsburgh Coke & Chemical Co.  
Celanese Corp. of America • Goodyear Tire & Rubber Co.  
E. I. Du Pont de Nemours & Co., Inc. • and many more.

# Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

**RICHARDSON SCALE COMPANY**  
Clifton, New Jersey

Atlanta • Boston • Buffalo • Chicago • Cincinnati • Detroit  
Houston • Memphis • Minneapolis • New York • Omaha  
Philadelphia • Pittsburgh • San Francisco • Wichita • Montreal  
Toronto • Havana • Mexico City • San Juan

Richardson Scales S.A. 1-3 Rue de Chantepoulet,  
Geneva, Switzerland



# ALUNDUM\* catalyst carriers benefit a wide range of processing

Norton ALUNDUM (fused alumina) catalyst carriers are characterized by excellent mechanical, thermal and chemical stability. They have high resistance to abrasion and erosion, and their low density is useful for packing and

filling applications. Catalytically, they are crystalline in nature and are produced in two surface area types; low and intermediate. Intermediate surface area carriers are subdivided into types A, B, C, with varying characteristics.

TYPICAL CHEMICAL ANALYSES (%s)			PHYSICAL PROPERTIES						
	LOW SURFACE AREA	INTERMEDIATE SURFACE AREA		Porosity	Water Absorption	Bulk Density	Vol. Bulk Density	Crystal Structure	Surface Area
Al <sub>2</sub> O <sub>3</sub>	89.4-76.6	77.0	Low Surface Area	40-50%	20-25%	1.90-2.10 gr/cc	65-80 lbs/ft <sup>3</sup>	Alpha Alumina	Less than 1m <sup>2</sup> /gram
SiO <sub>2</sub>	9.3-16.8	21.2	Intermediate Surface Area Type A	50-55%	28-30%	1.65-1.70 gr/cc	58 lbs/ft <sup>3</sup> (app)	Alpha, Gamma Alumina—chiefly Gamma	60-70m <sup>2</sup> /gram
Fe <sub>2</sub> O <sub>3</sub>	0.5-1.3	0.2	Type B	50-55%	28-30%	1.65-1.70 gr/cc	60 lbs/ft <sup>3</sup> (app)	Quartz, Alpha, Kappa, Delta Alumina	20-30m <sup>2</sup> /gram
MgO	0.1-0.6	0.4							
CaO	0.1-0.8	0.5							
Na <sub>2</sub> O	0.3-0.4	0.2	Type C	50-55%	28-30%	1.65-1.70 gr/cc	62 lbs/ft <sup>3</sup> (app)	Alpha Alumina and Mullite	5-10m <sup>2</sup> /gram
K <sub>2</sub> O	0.1-1.0	0.5							
TiO <sub>2</sub>	0.2-2.5	0.5							

## Shapes and Sizes

**Spheres:** (Low surface area) 3/16"-1" diam.; (Intermediate surface area) 1/4"-1/2" diam. **Pellets:** (All carriers) 1/8" x 1/8" — 1/2" x 1/2". **Rings:** (All carriers) 1/8" x 1/4" x 3/8" O.D. — 1" x 1 1/2" x 1 1/2" O.D.

## Typical Applications

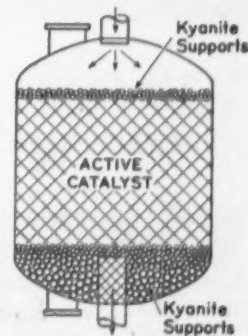
**Low Surface Area Carriers:** phthalic anhydride, maleic anhydride, ethylene oxide, protective atmospheres, synthetic gas generation, grates or suspending beds for active catalysts.

**Intermediate Surface Area Carriers:**

catalytic reforming, dehydrogenation, dehydration, sulfuric acid manufacture, nitric acid manufacture, dessicants.

## In Suspending Beds For Active Catalysts

In addition to the carriers described here, Norton produces catalyst supports for use in fixed bed converters where it is necessary to suspend active catalysts at a given level. Made of dense, rugged, chemically inert Kyanite material, these supports have great resistance to breakdown and have no chemically reactive effect on the processing.



## Get More Facts

on how ALUNDUM catalyst carriers and Kyanite supports can improve and economize your processing. Call in your Norton Refractories Engineer or write, mentioning your requirements, to NORTON COMPANY, 311 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.



**NORTON**  
REFRACTORIES

Engineered... **R<sub>x</sub>** ...Prescribed

*Making  
better products...  
to make  
your products better*





## L&N pH Control takes the bite out of acid-tainted waste

**The cooling water** pictured is intermittently contaminated by the acid operations of a large metals producer. When this occurs, it's piped to an acid leak lagoon, with other wastes such as washwater from acid tank-cars. But when discharged, the combined waste is in close-to-neutral condition, thanks to an L&N pH Control System—electrode assembly, Speedomax® recorder, Control Unit, Valve Drive.

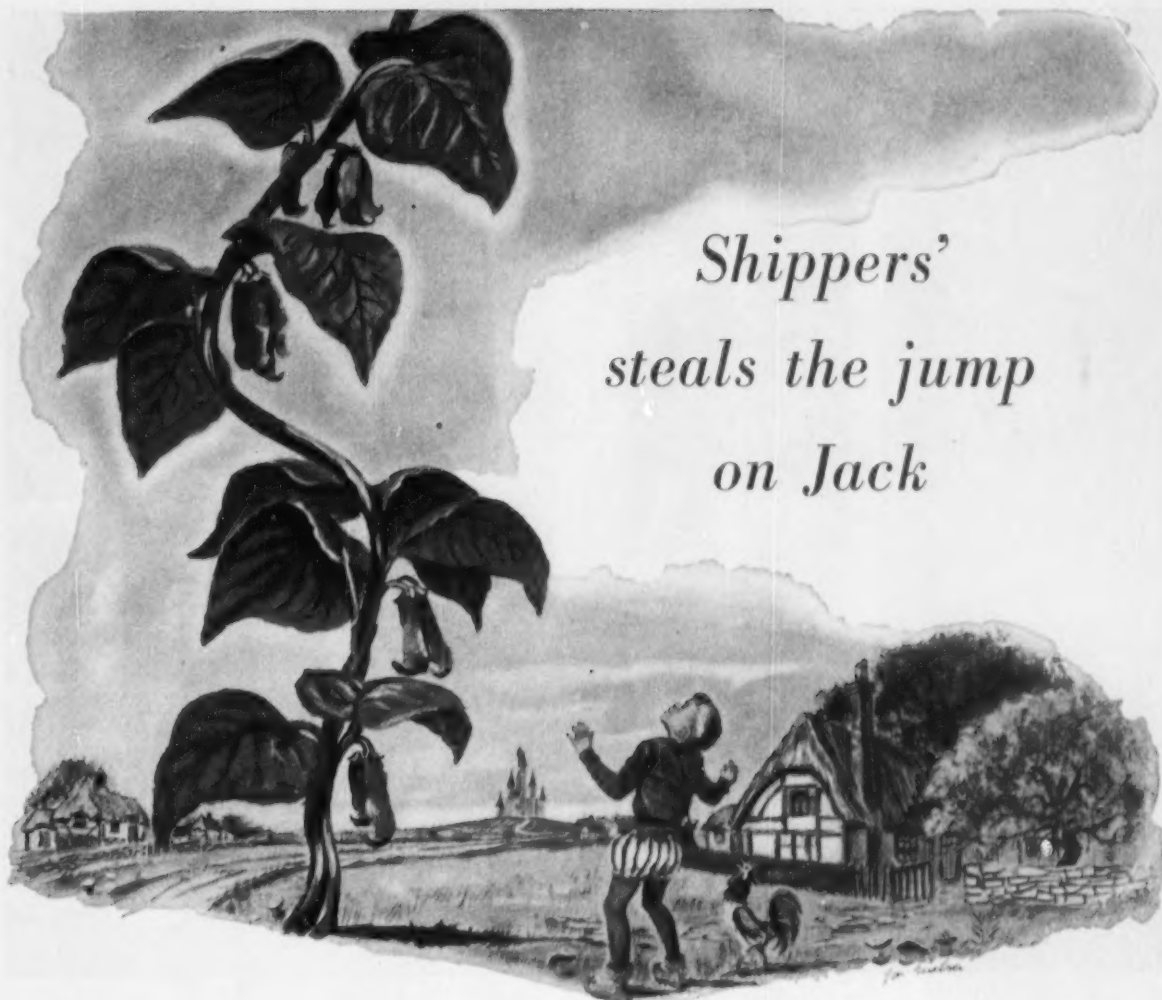
Although L&N pH equipment is taking the bite out of this highly acid effluent, merely purchasing the equipment didn't assure successful treatment. The first and most important step was a critical look at existing treatment facilities via L&N's unique pH Controllability Analysis. This appraisal of "controllability factors" such as flow,

concentration, retention, tells L&N specialists whether a process is actually controllable within the pH limits required, or what must be done to *make* it controllable. They translate these data into the answers you need to engineer an efficient treating system.

Process Data Sheet 700 (2) explains this unique, successful L&N approach to pH control in industrial waste treatment. Write Leeds & Northrup Company, 4916 Stenton Ave., Phila. 44, Pa.







## Shippers' steals the jump on Jack



Typical DURADOME . . . designed  
for vinyl acetate service.

Story-book magic may be all right for growing beanstalks, but it takes a lot more than "abracadabra" to make a tank car fleet grow.

Among other things, it takes planning, organization and not a little vision. But above all, it calls for the kind of *dependable* service which we have been delivering for 35 years. That's why so many leaders in American industry rely on Shippers' for modern tank car service.

For instance, since 1952, the number of Shippers' tank cars has increased more than 20%. That's a growth unparalleled in the industry, and makes Shippers' the fastest growing fleet on the rails!

As exclusive sales agent and lessor for QCF built DURADOMES, we'll be glad to help you determine the comparative advantages of rental or outright purchase. There's no obligation.

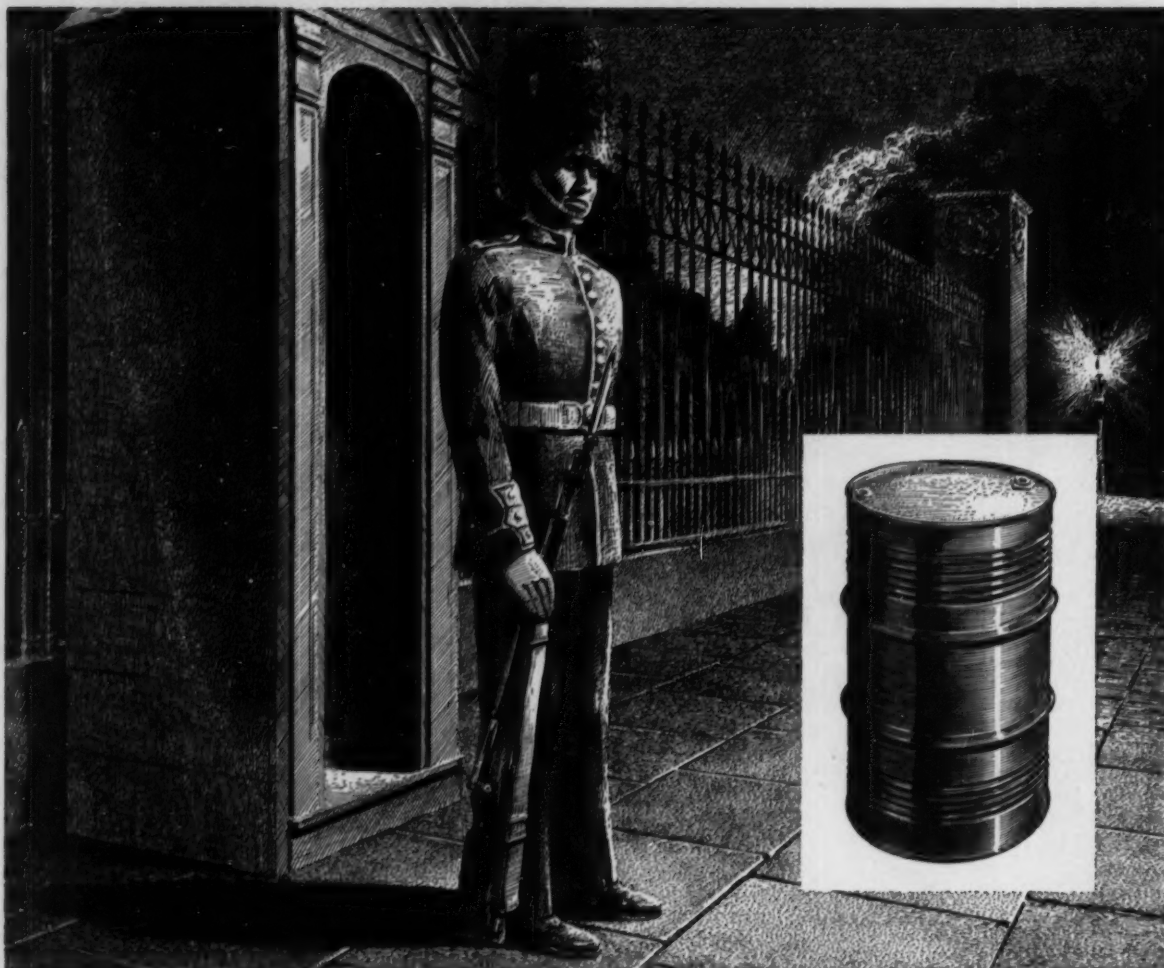


### SHIPPERS' CAR LINE

Division of QCF INDUSTRIES, Incorporated  
30 Church Street, New York 7, N. Y.

CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • CLEVELAND, OHIO • SMACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO. • RED HOUSE, W. VA.





## USS Steel Drums **guard** product purity

*Care*—a special kind of care—goes into the fabrication and finishing of every single USS Steel Drum. From selecting the right kind of rugged steel from our own mills, through the many processing steps of drum-making, until, finally, the component parts—spotless and gleaming—are ready for assembly . . . *care is the byword!*

A final step to insure product protection is the application of a special phosphate solution to the spotlessly clean and scale-free surfaces. The

phosphate coating not only guards against contamination and rust, but provides ideal bond for external paint surfaces. This combination of careful workmanship plus quality materials means that your product's purity is completely protected—from the moment it enters a USS Steel

Drum—until the drum is tapped in your customer's plant.

Make sure your products have the protection they need—always ship in USS Steel Drums. They are available in capacities from 2½ to 110 gallons. There are special fittings and openings for unusual needs.

### UNITED STATES STEEL PRODUCTS

#### DIVISION

United States Steel Corporation

Dept. 316, 30 Rockefeller Plaza, New York 20, N. Y.

Los Angeles and Alameda, Calif. • Port Arthur, Texas • Chicago, Ill. • New Orleans, La. • Sharon, Pa. • Camden, N. J.

# USS STEEL DRUMS

*"It's Better to Ship in Steel"*



UNITED STATES STEEL

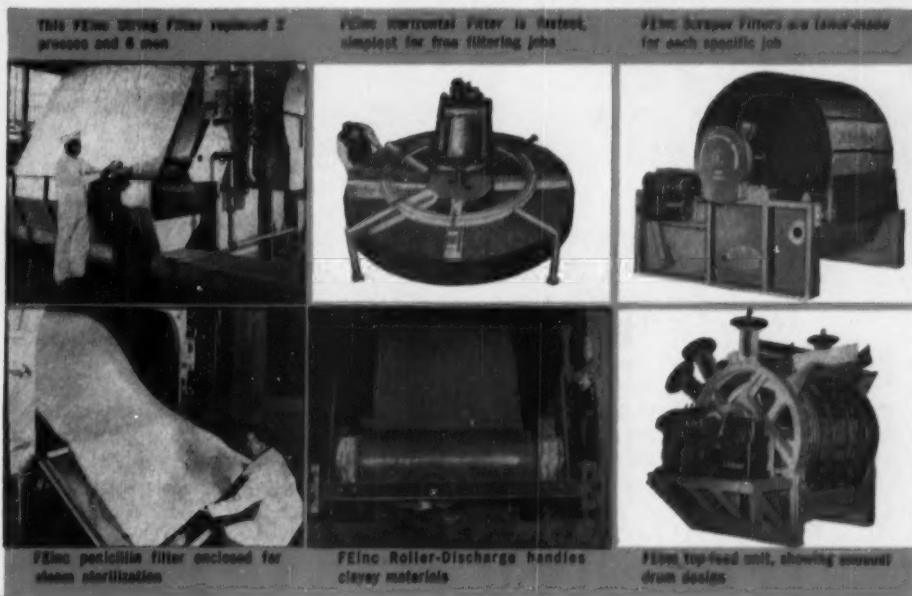


## CUSTOM DESIGNED FILTRATION

Get the last ounce of efficiency, at no extra cost  
...it adds up to big savings

When your filter runs hour after hour... month after month...  
a few points extra efficiency soon pays back the cost of the finest machine you can buy.

There's only one sure way to get this last ounce of efficiency:  
*custom design.* In all types of rotary vacuum filters, FEinc's *custom design* has  
consistently delivered whatever is required. Whether you want  
higher recovery of valuable solubles with less dilution... lower impurities in  
finished cake... 2-6% less moisture... or just higher output  
in limited floor space... FEinc can deliver. We'll be happy to conduct complete  
tests and submit recommendations. No obligation. Write today.



**FEinc**

FOR A BIGGER  
YIELD

**FILTRATION ENGINEERS, INC.**

SUBSIDIARY OF AMERICAN MACHINE & METALS, INC.

155 Oraton Street, Newark 4, N. J.

*Custom designed continuous filtration*





## No matter how you do it, get word to Morton for help in solving any salt problem

*The Morton Salt Company offers fast help from salt specialists—at no cost to you. And we mean on any salt problem. Morton can help you, whether it be consultation on the best grade or grades of salt for the best, most economical job in any phase of your particular operation . . . or help in planning a new water-softening system . . . or in modernizing or expanding a brine installation.*

We can dispatch a Morton Consulting Engineer in your area to your plant. He's an expert when it comes to solving salt problems, and he's backed by the services of chemists and salt scientists at Morton's ultra-modern salt research laboratory. Best of all, these services don't cost you a cent—and they may well save you hundreds of dollars.

Whatever your salt needs, Morton can fill them promptly and economically. Morton produces many grades of salt for use by the chemical industry. Only

Morton has nine strategically located plants to serve you. And only Morton can offer fast delivery from a bag to a trainload, at favorable prices and freight, anywhere in the country.

*Sending a carrier pigeon is recommended only if you happen to have one familiar with flight patterns to our communications window. The best way to get help, of course, is to write or wire.*

### **MORTON SALT COMPANY**

**INDUSTRIAL DIVISION**

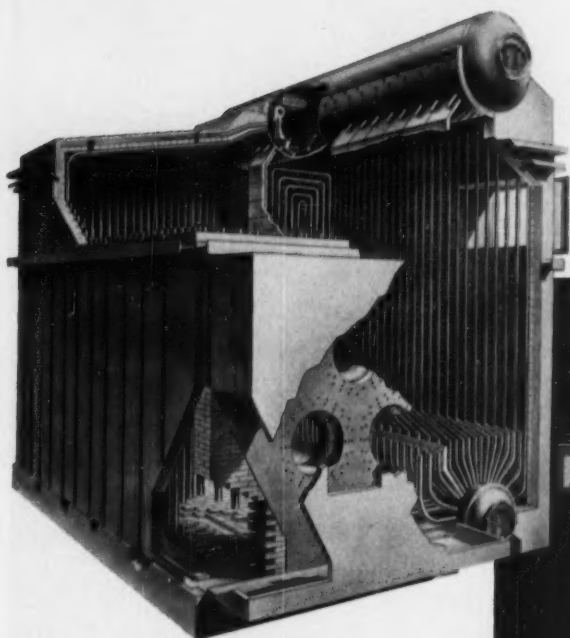
Dept. CE-12, 120 So. La Salle Street,  
Chicago 3, Illinois





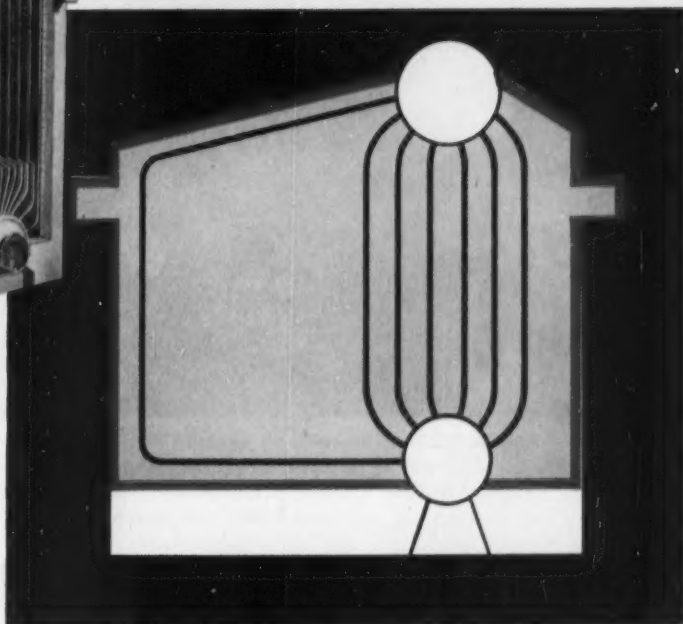
Another Feature of the FW Series "SC" Standard Boiler

# PRESSURE-TIGHT CASING



Cut-away view of Foster Wheeler "SC" Series Standard Steam Generator

permits  
**LOWER OPERATING COST**  
through  
**MORE EFFICIENT COMBUSTION**



## OTHER FEATURES AT A GLANCE

- Completely water-cooled walls
- Over 19-foot firing depth
- Unrestricted circulation
- Fully drainable superheater
- Efficient convection surface
- Bottom supported unit
- Steam purifying system
- Full insulation

THE ALL-WELDED steel casing of the Foster Wheeler Series "SC" Steam Generator forms a rigid, pressure-tight unit which can be arranged for either pressurized or balanced-draft operation.

By eliminating all possible sources of air or gas leakage, this pressure-tight design increases combustion efficiency and contributes to higher fuel economy per pound of steam per hour. No sliding seals are necessary as the stationary casing is welded to the drums and the differential in expansion provided for by an integral

horizontal expansion joint which encircles the entire unit. Pressure-tight ports are provided for observation of burners and flame.

These cost-saving FW Series "SC" Steam Generators are available in capacities from 50,000 to 150,000 lb/hr, for pressures to 1500 psi and superheated steam temperatures to 950F. For further information, write for Bulletin B-55-4, Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

# FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



# HOW *HERCULES* HELPS...

...KEEP FOUNDRIES 'ON SCHEDULE'



**MODERN DESIGN**—The New York Central's Aerotrain is typical of the new trains that were placed in service this year by the nation's railroads. Castings are vital to the production of such equipment and Hercules Truline® Binder helps foundries keep pace with the demand. Quick baking. Truline prevents oven bottlenecks, and Truline's easy collapsibility speeds finishing operations.

**NOW IN OPERATION**—At its new plant in Franklin, Va., Hercules is producing Pamak® tall oil fatty acids. These versatile chemical materials are finding ever-increasing use in printing inks, linoleum, paints, petroleum processing, disinfectants, detergents, flotation agents, and agricultural chemicals. A second plant for the production of Pamak is nearing completion at Savannah, Ga.

®HERCULES TRADEMARK



## HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

### HERCULES POWDER COMPANY

952 Market St., Wilmington 99, Del. Sales Offices in Principal Cities

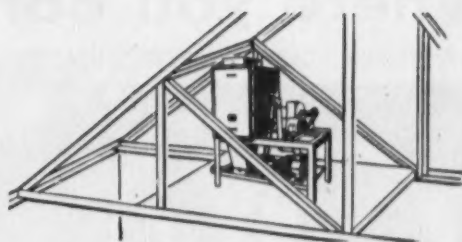
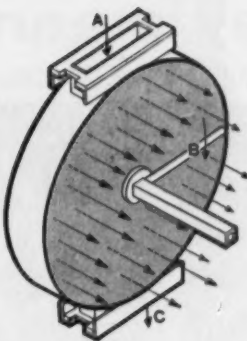
SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS.



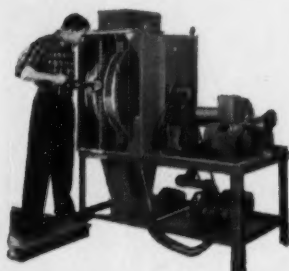
056-G



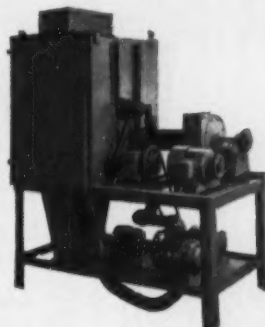
**1** Air and dust enter filter drum through top (A). Air passes out through filter disc (shaded) leaving dust on inside. Jet arm (B) rotates around disc blowing reverse-air jet back through filter, dislodging dust. Dust falls out bottom of drum (C) into hopper.



**2** Models from 520 to 4800 CFM capacities. Hang from rafters, place in corner, on platform—easily installed anywhere. Factory assembled—comes in "package."



**3** Automatic pressure control\* maintains ideal filter-surface conditions by cleaning filter discs only when they need it and not over-cleaning them. Continuous high-efficiency is assured, filters last longer.



**4** High-efficiency felt filtering material cleans more than 6 times as much air per sq. foot as ordinary woven cloth filters. Synthetic felts used for special applications. See how you can save time, money, space in your own operation with a Model D Aeroturn.

## **EXCLUSIVE!** Continuous automatic operation with New Koppers Model D Aeroturn Dust Collector . . .

**over 99.9% continuous efficiency!** The "heart" of this new Koppers Model D Aeroturn (see illus. 1) is the *reverse-air-jet action*. This reverse air cleans the filter discs, *maintains* ideal filtering conditions *automatically*! Pressure controls action by switching air jet arm "on" when pressure rises . . . "off" when pressure is normal for highest efficiency.\* When "on" the air jet arm rotates around bag radially—blowing an even-pressure air blast into the felt filter disc—agitating and dislodging dust accumulation, making it drop off inner wall into the hopper. No excess wear to "high-efficiency" felt disc—no unnecessary use of air jet mechanism—no stopping to clean filter. This completely automatic "package" dust collector solves your filtering problems with over 99.9% *maintained* efficiency.



New Series 12 Aeroturn for bigger dust filtering jobs, material reclamation. Standard sizes from 1,000 to 60,000 CFM—special units designed for greater capacities. Up to 99.9%+, a high "clean-air" efficiency.



Koppers Company, Inc.  
Metal Products Division  
Industrial Gas Cleaning Dept.  
**Engineered Products**  
**Sold with Service**

### **AEROTURN DUST COLLECTORS**

*Mail this coupon today!*

KOPPERS COMPANY, INC., Industrial Gas Cleaning Dept., 5012 Scott Street, Baltimore 3, Maryland.

Gentlemen: Please send me a free copy of your Aeroturn Booklet with description, drawings and photographs. ☐ Model D ☐ Series 12

Name..... Title.....

Company.....

Address.....

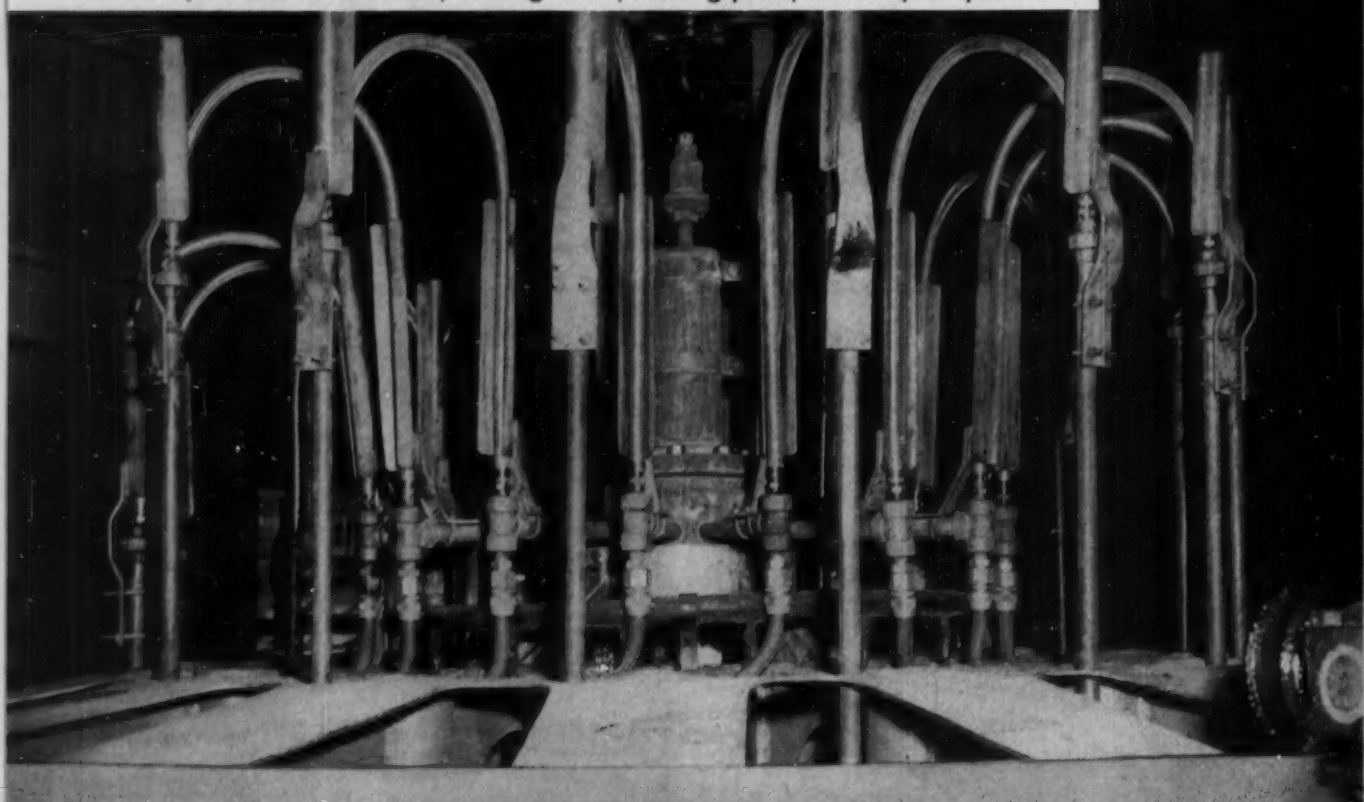
City..... Zone..... State.....

\*Hersey Patents



# Where you convey steam

and have problems of vibration, misalignment, moving parts, or cramped space.



LIVE STEAM flows through this American stainless steel hose at 230 pounds per square inch at 390°F. Hose flexes over 100 times an hour.

***You get absolutely "tight" conveyance — under high or low temperatures and pressure—with American Flexible Metal Hose!***

Live steam "on the loose" can be costly . . . and dangerous. That's the problem facing the Diamond Match Company. The job: conveying live steam around a 180° bend . . . in a conveyor which must undergo continuous flexing.

Many lines were tried—and failed. American stainless steel hose was finally suggested, and is now doing the job! This is not unusual. American flexible metal hose has a long record of peak performance in the field.

It absorbs vibration and prevents its transmission to surrounding structures . . . absorbs expansion and contraction in lines due to temperature changes . . . facilitates installation, especially in cramped spaces . . . and solves the problems of misalignment.

Available in wide range of diameters in tough bronze, steel, super nickel, brass, stainless steel and other metals, American flexible metal hose delivers the very highest service hours per dollar. American furnishes flexible metal connectors to your specifications . . . ready for immediate installation.

Consult your nearby American Metal Hose representative for engineering help when planning your next job. No obligation. See American Brass Company or Anaconda in your phone book—or write: American Metal Hose Division, American Brass Company, Waterbury 20, Conn.

BB178

WHEREVER CONNECTORS MUST MOVE

**AMERICAN**

*flexible metal hose and tubing*

AN **ANACONDA**<sup>®</sup> PRODUCT

**Contact American to solve problems of . . .**

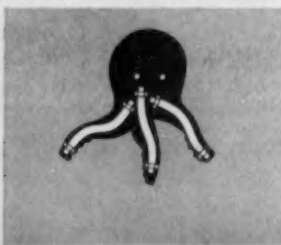
**MISALIGNMENT**



**VIBRATION**



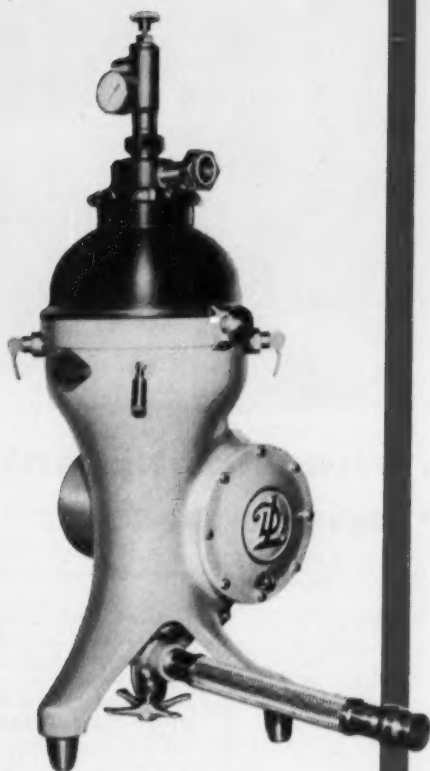
**CRAMPED SPACES**



**MOVEMENT**







# **PERFECT FOR YOUR PILOT PLANT... DE LAVAL 244 HERMETIC**

If your problem involves the effective and economical separation or clarification of viscous, inflammable, or "free from contact with air" materials, investigate De Laval's 244 Hermetic. Small in size... minimum auxiliary equipment needed... exclusive De Laval "Finger Tip Control" for maximum flexibility... the 244 Hermetic fits perfectly into pilot plant operations. Find out today, how De Laval's 244 Hermetic Centrifuge can help provide accurate determination runs... advance information on what to expect in the operation of your plant.

***Get all the facts...  
Write De Laval...Now.***



**DE LAVAL**  
SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.





## Designed for use in chemical plants WAGNER EP MOTORS

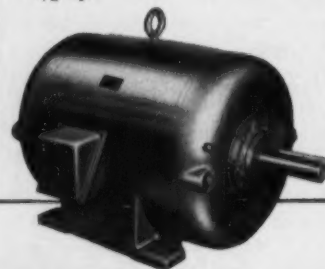
Here are stock motors specifically designed for the chemical industry—they're fully protected against corrosive fumes and liquids, dust, dirt or moisture.

Such protection is assured by totally-enclosed fan-cooled construction in corrosion-resistant cast iron frames. Extra protection is given the laminations by a wall of cast iron that completely surrounds the stator. Even though the

windings are completely enclosed, they are treated with a special coat of varnish that resists acids and alkalis. A running shaft seal, sealed leads and a gasketed conduit box give still further protection to these motors.

A skilled Wagner engineer, expert in motor applications, can help you select the Wagner Motor that meets your most exacting specifications. Call the nearest of our 32 branch offices, or write us.

Wagner Chemical Plant Motors are available in ratings from 1 to 250 hp in standard (Type EP) and explosion-proof (Type JP) designs, and in Non-ventilated corrosion-resistant standard and explosion-proof types in ratings from  $\frac{1}{2}$  through  $1\frac{1}{2}$  hp.



**Wagner Electric Corporation**

6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES



# How to pick the 1 tubing steel out of 24 to give you longest tube life per dollar

*Ask the experts!*

OF THE 24 different high-temperature tube steels the Timken Company offers to solve your heat, pressure, corrosion and oxidation problems, *one* analysis is most exactly suited to your particular needs, to give you maximum tube life per dollar of cost.

To find this analysis, *ask the experts.*

These experts are the metallurgists of The Timken Roller Bearing Company. The benefit of their more than 20 years of steel research and experience—with emphasis on high-temperature steels—is yours for the asking. They'll help you select the analysis that will give you longest tube life for your money—the only true measure of actual tube steel cost.

Whichever analysis you choose, you can be confident of uniform quality. The Timken Company maintains rigid quality control from melt shop through final inspection.

Why not let the Timken Company's metallurgists help pick the tubing steel that can solve *your* problem? *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

*This month's report is on:*

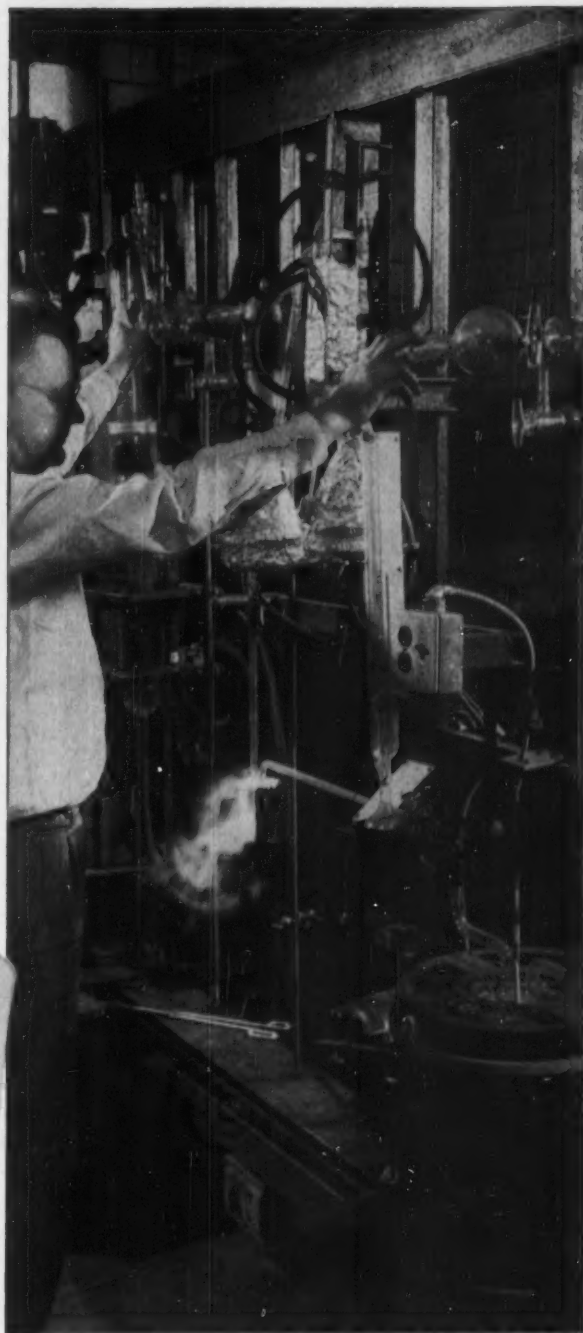
## 18-8 STAINLESS

An austenitic, non-magnetic alloy that shows the best combination of creep strength, oil corrosion resistance and oxidation resistance for service up to 1500°F. For use in oil cracking systems, hydrogenation equipment, high temperature oil and steam piping, superheater elements, heat exchangers.

### ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

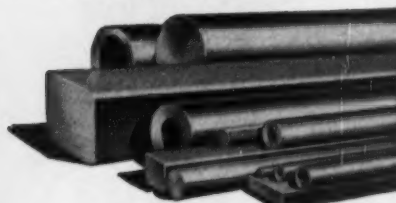
Carbon	Sicromo 2	Sicromo 5S	18-8Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti	18-8 Cb	16-25-6**

\* Available as seamless tubing on an experimental basis only.  
\*\* Not available as seamless tubing.



To help control exact steel analysis, a steel sample is melted in this vacuum fusion apparatus. Then gases are pumped out, and the amount present in the steel is determined.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH



**TIMKEN**  
Fine Alloy  
**STEEL**

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

CHEMICAL ENGINEERING—December 1956





## **RIGHT** *on all counts!*

- **inherently right**, because of Weston's exclusive design and advanced manufacturing techniques
- **easy-to-read right**, because they read with on-the-button accuracy, at a glance
- **and right** for budget reasons, because they give trouble-free service for years — bring thermometer costs 'way down

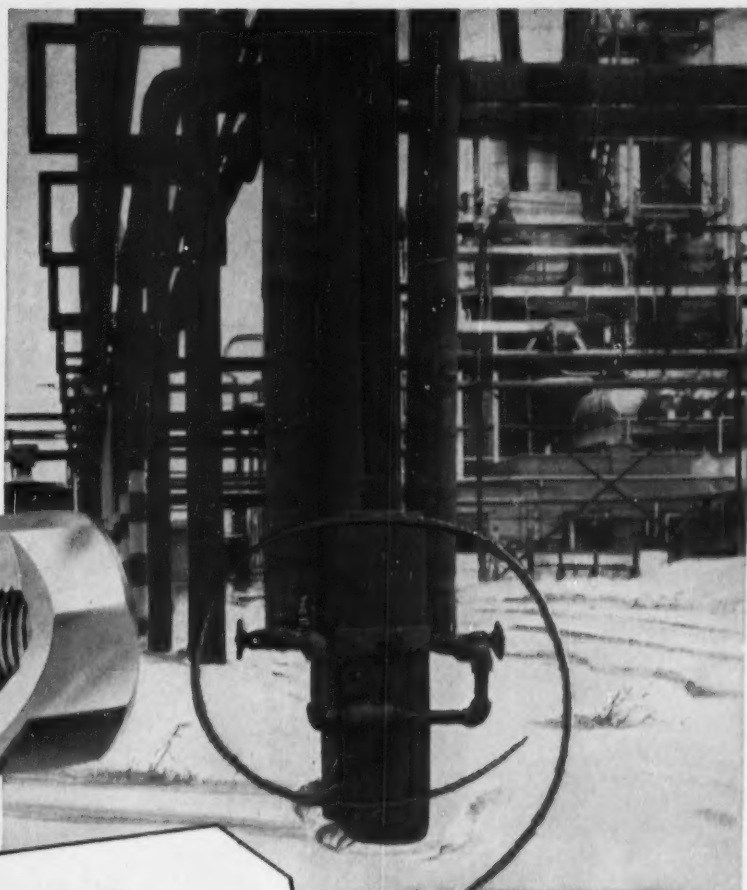
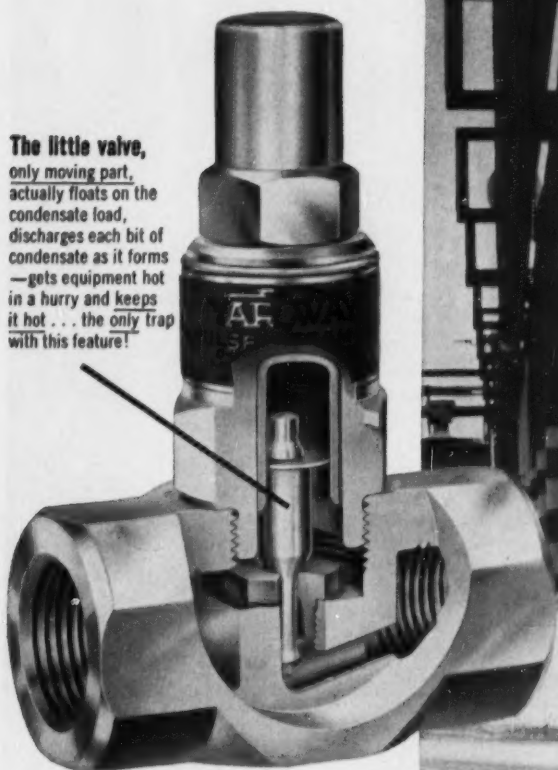
Weston bimetal thermometers are available in types, sizes and ranges for industrial as well as laboratory needs. Bulletin T13 gladly sent on request. Weston Electrical Instrument Corporation, Newark 5, New Jersey.

**WESTON**  
*Bimetal*  
**THERMOMETERS**





The little valve,  
only moving part,  
actually floats on the  
condensate load,  
discharges each bit of  
condensate as it forms  
—gets equipment hot  
in a hurry and keeps  
it hot . . . the only trap  
with this feature!



**PREPARED  
FOR WINTER!**

Is your plant ready for cold weather?

Steam lines and process equipment equipped with Yarway Impulse Steam Traps are prepared for winter:

- . . . protected against freeze-ups.
- . . . capable of operating at high even temperatures.
- . . . ready for peak production loads.

The little valve of the Yarway Impulse Steam Trap (only moving part) continually tests for condensate, discharges each bit as it forms, prevents freezing.

Combined with other important Yarway features—fast equipment heat-up, stainless steel construction, small size, light weight, good for all pressures without adjustment, low initial cost—this adds up to the best winter trapping you can buy.

Check your traps now. Then call the Yarway distributor for the Impulse Traps you need. 270 of these distributors, one near you. We'll gladly send you his name also the latest Yarway Steam Trap Bulletin. Write to . . .

**YARNALL-WARING COMPANY**  
137 Mermaid Avenue, Philadelphia 18, Penna.

**YARWAY**

**impulse® steam trap**

The impulse that revolutionized steam trapping 20 years ago.





Dravo workmen complete inspection of four 8,000 gallon liquid batch blenders

## The buyer of this process equipment didn't have to raise the roof

Ever face this problem? When new production equipment is larger than available space, something must be changed. Either you raise the roof or find a supplier to design within your limitations. In this case, four liquid batch blenders of 8,000 gallon capacity were required by a large chemical process firm. Working closely with the customer, Dravo's Process Equipment Department maintained required capacity within height limitations two feet lower than originally specified. A

special short-stroke discharge valve was designed to operate within the reduced space. The bottom-entering agitator drive mechanism had to be removable through the restricted clearance above the floor for easy servicing . . . without moving the blender.

The solution of this liquid blender problem is typical of the custom service available to the chemical process industries from Dravo Corporation. Special and large-scale equipment is designed and fabri-

cated to meet particular production requirements in the chemical, food, rubber, plastics and allied fields.

Send for Process Equipment Bulletin No. 236. Write to Dravo Corporation, Pittsburgh 25, Pa.

# **DRAVO**

C O R P O R A T I O N

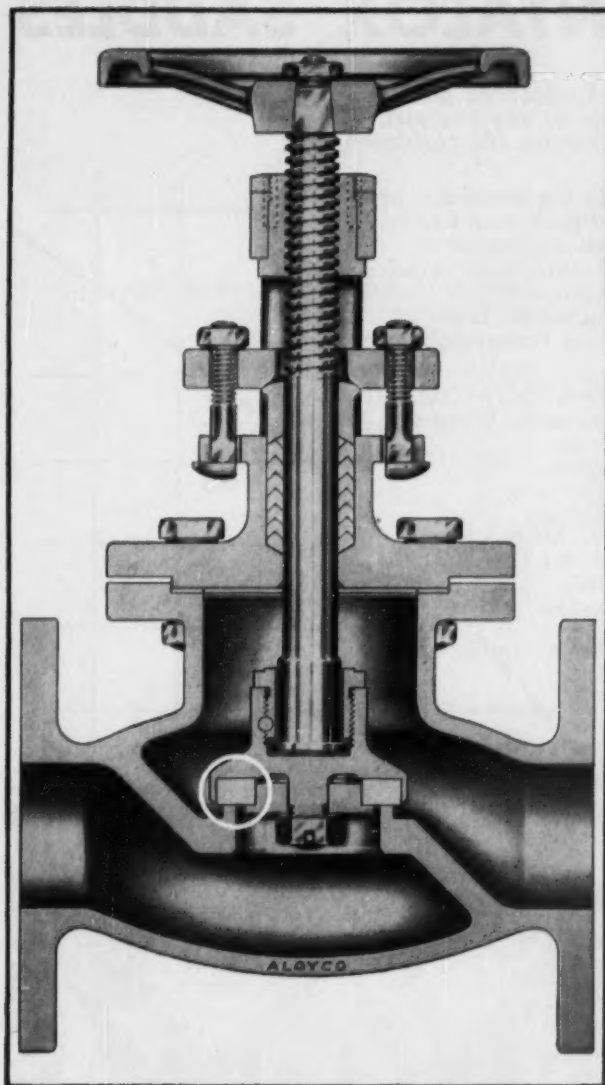


Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation



# Teflon\* forms gas-tight seal in corrosion resistant Aloyco valves

\*Registered DuPont trademark.



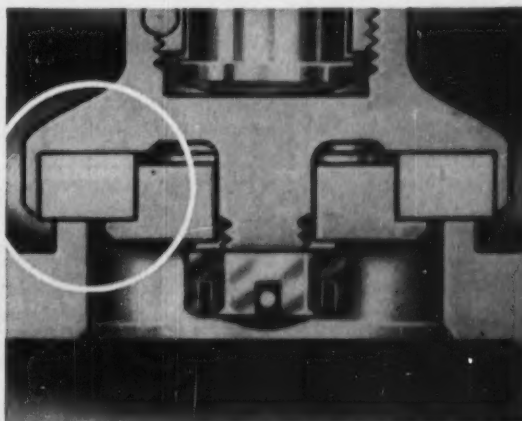
Hard-to-hold volatile or elusive fluids—even if highly corrosive—can't leak past the Teflon discs or packing in this Aloyco valve.

The reason? Teflon's ability to form a gas-tight seal under compression—even when the seating surface or adjoining metal is slightly corroded. That's why Teflon-equipped valves outlast and outperform valves with metal-to-metal seating surfaces in handling volatile corrosive fluids.

Add to that the fact that Teflon has high impact strength under hydraulic shock loads, and is inert to almost all chemicals up to 500° F., and you'll see why Aloyco pioneered the use of this unique material for discs, seats and packing in corrosion-resistant valves.

Aloyco valves with renewable Teflon discs, seats, and packing come with screwed or flanged ends in a variety of styles: globe, Y, angle, swing-check, needle, plug-gate—as well as sampling valves. You'll find them all described in our new bulletin No. 11. Mail coupon below for your copy.

64



**ALOYCO GLOBE VALVE** holds Teflon disc securely against possible overload.



Subsidiary of Walworth Company

Alloy Steel Products Company, Inc.  
1301 West Elizabeth Avenue  
Linden, New Jersey

Gentlemen:

Please send me a free copy of your new Bulletin No. 11 on Aloyco valves with renewable Teflon discs or seats.

Name

Firm

Address

City  Zone  State



# THE LIQUID CARBONIC CORPORATION ABSORBS CO<sub>2</sub>



## 51% MORE EFFICIENTLY WITH INTALOX SADDLES

At Oakland, California, The Liquid Carbonic Corporation produces 50 tons per day of dry ice that eventually finds its way into such diverse applications as the refrigeration of ice cream, the production of dyestuffs and the slaughtering of hogs.

"INTALOX" Saddles play an important role in the economics of manufacture of solid CO<sub>2</sub> at Oakland. Used to pack an 8 foot diameter tower in which CO<sub>2</sub> is absorbed from a combustion gas, "INTALOX" Saddles are giving over 51% more mass transfer efficiency than do Raschig Rings under the same conditions. Also, the higher proportion of free space in the packed beds has led to a 40% reduction in gas pumping cost because of the lower friction drop.

This is only one of the many installations where "INTALOX" Saddles are helping to cut capital and operating costs. Whether it be the absorption of H<sub>2</sub>S in diethanolamine, the separation of fatty acid esters under high vacuum rectification or the manufacture of soluble coffee in a liquid-liquid extraction process, "INTALOX" Saddles permit the least costly and the simplest design. Shell diameters and wall thicknesses are smaller, tower heights are shorter, liquid redistribution is less frequent and pumping equipment is less expensive.

"INTALOX" Saddles are available in sizes ranging from 1/4" to 2" in White Chemical Porcelain and standard Chemical Stoneware.



GREATER THAN 50% MORE MASS TRANSFER EFFICIENCY



MORE THAN 40% SAVINGS IN GAS PUMPING COST

Write for a copy of Bulletin S-29 filled with technical data on Tower Packings that every engineer can use.

INTALOX  
SADDLE  
PACKING

Process Equipment Division

**U. S. STONEWARE**

AKRON 9, OHIO

371E



DECEMBER 1956

# • Chementator

H. T. SHARP

- ✓ **Boeing and North American Aviation are reported to have been awarded Air Force contracts to design a supersonic bomber to be powered by chemical fuels. Most likely fuel: an alkyl borane.**
- ✓ **With government backing, several Japanese chemical firms are studying plans to set up a synthetic rubber industry on the island.**
- ✓ **England's Imperial Chemical Industries will give the free-piston engine its first process-plant tryout. Fifteen 1,000-hp. Pescara units will drive large rotary gas compressors in a new plant at Durham.**
- ✓ **At least three companies are studying a new liquid-liquid extraction process for separating and recovering tantalum and columbium. Developed at AEC's Ames labs, process dissolves ore concentrate in HF, extracts the metals with methyl isobutyl ketone.**

## **TVA maps new nitric phosphate route**

Tennessee Valley Authority now has under development at Wilson Dam, Ala., a new method for producing nitric phosphate fertilizers. This process is expected to greatly simplify the equipment needed and put plant costs within reach of most fertilizer makers.

Early test runs in TVA's continuous ammoniator pilot plant show promise that this type of equipment, already used by the industry for ammoniating superphosphate, can be used instead of more costly slurry-type ammoniation and granulation steps of earlier TVA nitric phosphate processes. If successful, it would cut equipment costs by 50% and mean lower operating costs too.

Many existing granulation plants could easily be adapted to use the new process by adding a relatively inexpensive acidulation unit and a few minor changes. And the equipment would be versatile enough to handle both nitric phosphate and conventional processes.

A disadvantage of all present nitric phosphate processes both TVA and European (see *Chem. Eng.*, Oct. 1956, p. 358) is that they require large, expensive plants for economical operation and they can't make as many grades as most manufacturers deem necessary. Though work is far from completed, TVA thinks it has a winner this time.

## **"Liquid ion exchange resins" hunt uses**

Selective solvents developed primarily for uranium extraction and now threatening ion exchange's prime position in uranium processing (*Chementator*, May 1956, p. 104) may well limit the scope of continuous ion exchange processes that are now being developed, before they are even perfected.

The reason: These solvents act like "liquid ion exchange resins," not like conventional solvents. They give up ions and form complexes with the material being extracted. As with solid ion exchange resins, chemical equilibrium, not solution equilibrium, is controlling.



Easier to handle than solid resins, use of these liquids eliminates the need for break-down-prone solids-handling devices and large resin inventories in continuous ion exchange systems. For many uses, continuous ion exchange could be carried out in conventional liquid-liquid extraction equipment.

Some of these materials (usually organo-nitrogen and organophosphorus compounds) have been known for years, but limited availability and high cost discouraged commercial interest. Then researchers at AEC's Oak Ridge labs found, while screening organic reagents for extracting uranium values from sulfuric acid solutions, that these materials were selective solvents for uranium and vanadium.

This work resulted in the development of two extraction methods—the dialkyl phosphoric acid process (DAPEX), now being pilot-planted by Kerr-McGee at Shiprock, N. M., and Climax Uranium at Grand Junction, Colo., and the amine extraction process (AMEX), being piloted by Eldorado Mining & Refining at Port Radium, N. W. T., Canada. Other firms and the Bureau of Mines are also known to be studying these and similar processes.

Chief disadvantage and a major cost in these extraction systems is loss of costly solvent to the aqueous phase. Though the growing use of this separation approach in uranium processing has spurred some chemical firms to increase production of these solvents, resulting in greater availability and somewhat lower prices, such losses will limit the usefulness of these materials.

Concentration of the material to be recovered and its value will likely determine whether conventional ion exchange or selective solvents should be used in a specific case. Ion exchange is favored for recovering trace elements and materials of low value.

Engineers close to these developments expect these ion-exchange-like solvents to play an increasingly important role in recovering valuable metals, such as uranium, thorium, vanadium and zirconium. Some look for the technique to find its greatest usefulness in processing spent nuclear reactor fuel.

### Want to buy a wax-from-bark process?

Oregon State Board of Forestry is still hunting a buyer for its wax-from-Douglas-fir-bark process. In its latest move the board has sent an explanatory brochure to logical cus-

tomers—firms who've already expressed interest and nearby lumber-byproducts makers who seem best fitted to use the process.

The board is asking \$10,000 for access to its files on the process. In these files are the results of surveys and pilot-plant investigations made by M. W. Kellogg, which dropped its option on the process last spring after a long and comprehensive study (*Chementator*, Apr. 1956, p. 108).

Although ready to negotiate an outright sale, at this stage the board proposes a non-exclusive licensing arrangement. It feels that royalty payments of 3% of gross sales for such competitive products as refined waxes, wax byproducts and tannins and 5% of gross on dihydroquercetin or emulsifiable wax are reasonable expectations.

Prospects were advised that an unnamed eastern firm is interested in undertaking a joint venture with a company that has an assured raw material supply. The eastern firm reportedly stands ready to put up 51-70% of the required capital.

### Metal recovery process shows new life

The adage that "nothing succeeds like success" applies to chemical processes, too.

The troubles that plagued some of the early operators of the high-temperature, high-pressure, chemical-reduction process that Chemical Construction Corp. and Chemetals Corp. worked out for metals refining (*Chem. Eng.*, June 1952, p. 164) have long discouraged industry enthusiasm for the process. But now that these troubles appear to be ironed out, there's evidence of renewed interest.

Biggest project in the works is Freeport Sulphur's plan to extract nickel and cobalt from deposits at Moa Bay, Cuba. Freeport has piloted the process for several years, now plans to mine and sulfuric-acid-leach the ores in Cuba, ship them to U. S. for reduction and metals recovery.

Hydrometals, Inc., plans to use the process on cement coppers and copper scrap in a plant to be built in Chicago. Fluor Corp. will design and build the unit.

Fluor has been operating the Kansas City plant of Whitaker Metals for some months. Designed to make electrolytic-grade copper from scrap, the 5-ton/day plant ran into operating difficulties soon after going on stream.

(Continued on page 108)





This customer's pre-test confirmed desired results prior to purchasing a p-k production model Twin Shell blender. Prove it yourself by pre-test.

## Pre-Tests "Guarantee" Performance of P-K Twin Shell Blenders\*

There's never a question as to whether a p-k Twin Shell Blender will do the job. For p-k's "pre-test" service, described at right, removes all guesswork and *proves* that a p-k blender will give you the results you need . . . whether it be a standard model Twin Shell for gentle mixing action, an "Intensifier" model for difficult-to-blend materials, or p-k's new "Liquid-Solids" blender, designed for blending liquids into dry materials.

Actually this blending pre-test of your materials is just an extra safeguard. For p-k's remarkable Twin Shell blenders . . . with their unique blending action . . . probably have *already* proved their effectiveness

on a job like yours.

Take a look at the V-shape of the shell. In every revolution there's a 5-way tumbling and mixing action *that you can't duplicate in any other blender*. Blending is fast, thorough, and results are consistently uniform.

Add to this the fact that clinical cleaning is a snap in the smooth, baffle-free, interior . . . that loading and discharge is simplified through the ample openings . . . that maintenance is negligible . . . and that blending results obtained with any p-k lab model (from 1 pint working capacity up to 8 quarts) scale-up to production sizes.

\*Patented and Patents Pending

## Investigate P-K's Blending Concept

P-K's Customer Service Laboratory will be pleased to test-blend your materials . . . preferably under your supervision. Material formulations will be blended to your exact specifications and returned for analysis, together with a complete report. P-K recommends pre-tests for all "Liquid-Solids" applications, because of the many variables that may effect blending procedures necessary for intimate dispersion of liquids in solids. Our Lab also conducts comparison tests in pilot models of all other basic blender types . . . from ribbon and double cone to p-k's standard Twin Shell and "Intensifier" models.

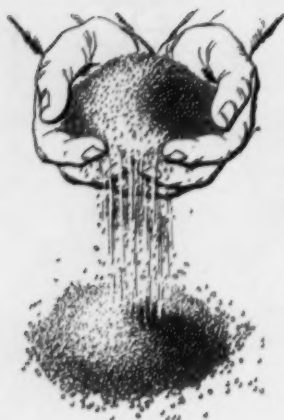
All of them are members of a growing family of p-k blenders and all are described in our new catalog 14. Write our Mr. R. T. Dotter for your copy . . . and arrange, too, for a pre-test of your materials.

The Patterson-Kelley Co., Inc., 220  
Hanson St., E. Stroudsburg, Penn.

**Patterson Kelley**  
Chemical and Process Division

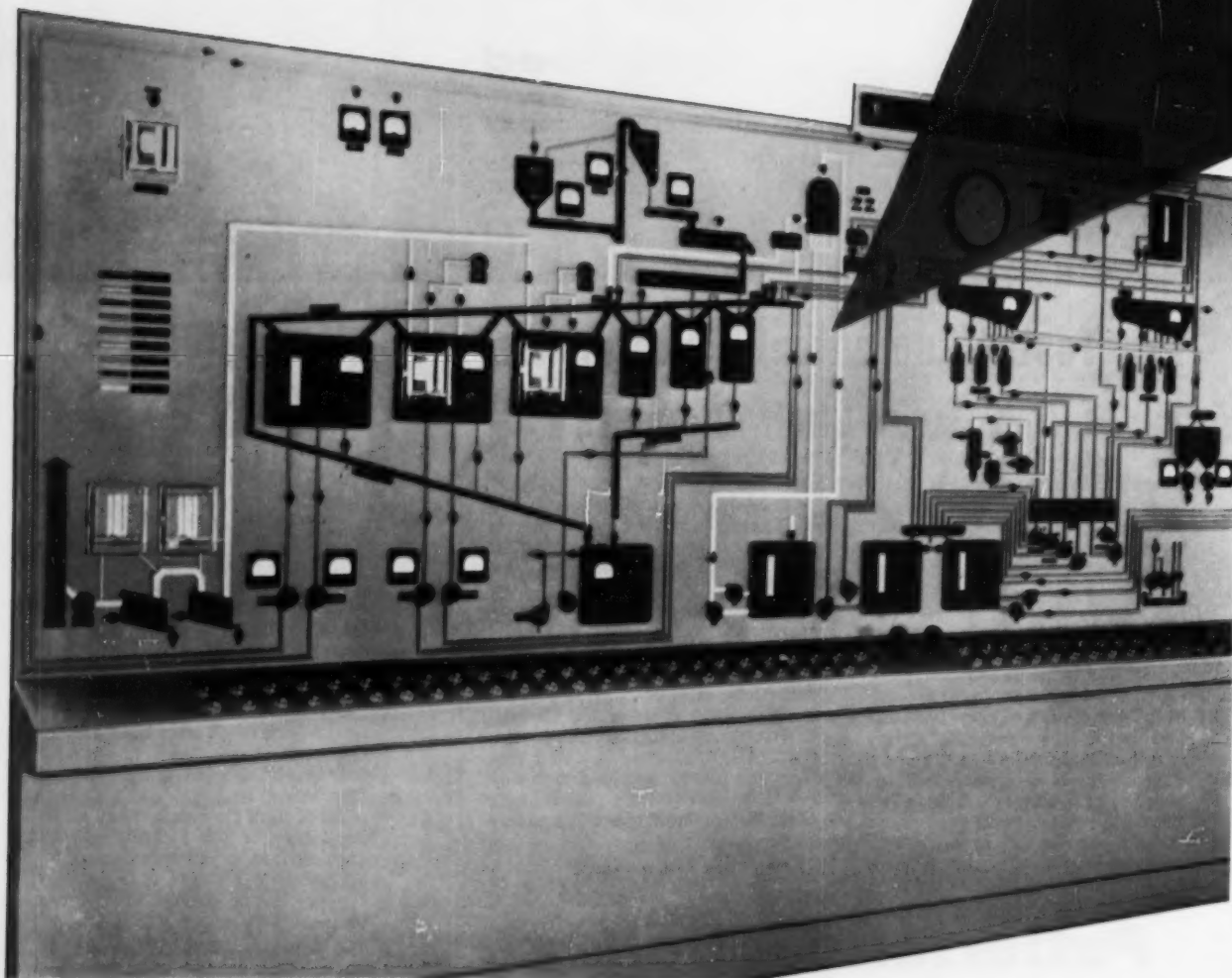
P-K Twin Shell Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors\*





**FREE-FLOWING  
GRANULES . . .**

Important characteristic of high analysis  
chemical fertilizers produced by  
Dorr-Oliver designed plants.

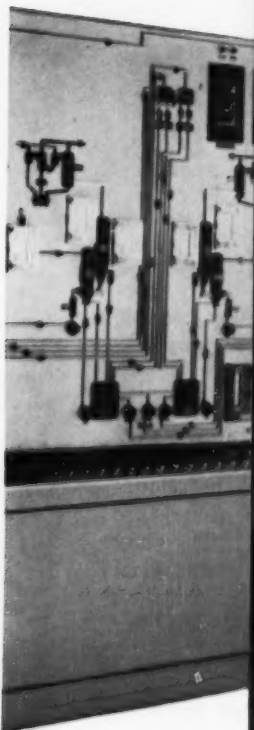


New graphic control panel, supplying push-button control, for Europe's newest phosphoric acid plant.



# Nerve Center of Europe's Newest Phosphoric Acid Plant

**designed—engineered—  
equipped by Dorr-Oliver**



Europe's newest phosphoric acid producer selected Dorr-Oliver as designers and engineers for their new project. This new, fully automatic plant, one of the largest in the European fertilizer field, is being constructed with the assistance of the combined world-wide facilities of the Dorr-Oliver organization. The plant was designed by D-O's Consulting Engineering Dept., Stamford, Conn.; and by taking advantage of favorable world-wide prices, the necessary plant equipment was supplied from D-O Associate Companies in London, Milan, and Amsterdam.

Dorr-Oliver's Consulting Engineering Department, with 40 years' experience in the field of concentrated fertilizer production via the wet process of manufacturing phosphoric acid, is staffed by engineers fully qualified to handle all phases of fertilizer plant design — from economic analysis to supervision of initial operation.

If you are considering entering the fast growing fertilizer field — or if you plan to expand present plant facilities — it will pay to check with Dorr-Oliver. Write for Bulletin #8000, or better still, let us send an engineer to discuss your problem from the standpoint of economics and process. No obligation, of course.





Fluor has made equipment and operating changes to improve the plant's performance. At the same time, Fluor feels, its engineers gained the know-how needed to design and build future plants.

Up until a few months ago, when it was sold to Electric Bond and Share (*Chem. Eng.*, July 1956, p. 373), Chemico handled design and construction of plants using this process. After the sale, patent rights remained with Chemico's former owner, American Cyanamid. Chemetals, one of the originators of the process, handles licensing for copper recovery only.

Though many industry people speak of renewed interest in the process, and reports are heard of several firms about to announce plants, spokesmen for American Cyanamid say that present interest is at an engineering level, that no new firms have applied for licenses to use the process. No longer in the plant construction business, Cyanamid might bring Fluor into the picture if a partner is needed to handle the design and construction phases of plants for process licensees.

### Lummus offers new urea process

Confirming an earlier report (*Chementator*, Feb. 1956, p. 105), Lummus Co., New York, has just announced that it is ready to license what it calls a "tried and improved" process for making high-purity urea.

Developed by Lonza Electric and Chemical Works, Basle, Switzerland, and operated there for over ten years, the process claims high yields per pass and low operating costs. Improvements made during these ten years are said to have increased the flexibility of the process and improved product purity.

Since U. S. patents haven't issued, Lummus won't talk yet about how the Lonza process works. But it reports that several firms are already interested in using it.

### AEC releases 56 more patents

By adding a batch of 56 patents to its list late in October, the Atomic Energy Commission raised to 1,046 the number of patents and patent applications it has released for licensing. A part of its program for making nonsecret technical information available to industry, the commission grants nonexclusive, royalty-free licenses on these patents.

A few of those in the latest group that are of interest to chemical engineers include:

- Solvent extraction process to separate and recover zirconium and hafnium values (U. S. 2,753,250).

- Process for recovering nitric acid from metal nitrate liquors (U. S. 2,757,072).

- Electrical leak detector for pipe joints (U. S. 2,759,175).

- Apparatus for countercurrent, liquid-liquid extractions between liquids of different densities in which jet nozzles are used to mix the liquids (U. S. 2,759,801).

Numerous other processes, instruments and pieces of equipment are described in the patents. A list of available patents can be gotten from the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington. Applicants for licenses should apply to the same office.

### Pulp process sparks Grace expansion

A newly perfected continuous process for pulping sugar-cane bagasse for making paper is the foundation of a \$46-million expansion program that W. R. Grace has just launched in Central and South America.

Called the Peadco process (for Process Evaluation and Development Co., the patent owner), the new pulping method features ultra-rapid processing. It cuts pulp cooking time from several hours to about five minutes.

In addition, Grace claims that pulp made by the new process has more uniform quality, lower reagent requirements and can be run easier and faster on high-speed paper machines than pulps made by older batch processes. Lower capital and operating costs, higher yields and greater flexibility are also claimed.

At present both Grace and Peadco (jointly owned by the developers of the process—Grace, frozen-food-process inventor the late Clarence Birdseye and paper-machinery maker John W. Bolton & Sons) are reluctant to discuss process details. They say only that plants will use standard commercial types of shredders, screens and cookers, as well as standard pulp-washing and bleaching equipment—but that some pieces of equipment must be altered a bit.

A modified alkaline cook is used for most types of pulp.

Though it's not ready to talk about the process, Grace is set to put it into widespread

(Continued on page 110)



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## **NEW! Valuable Information on Sulfuric Acid in this big, fact-packed data book...**

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use. In addition to a \$2-million, 50% expansion at Paramonga, Peru, where the process was developed, the company has signed contracts for a \$9-million plant to be built at Cali, Columbia, and a \$7-million plant in Puerto Rico, where it has also bought a carton and box plant to use the paper mill's output.

Negotiations now under way are expected to result in plants in Cuba, Mexico and Brazil. (The Brazilian plant will process eucalyptus instead of bagasse.)

An old hand both at making paper from bagasse (*Chem. Eng.*, July 1952, p. 286) and at doing business in Latin America, Grace will gear output from each plant to consumption in that country. Locally produced raw materials will be used, and there will be no exports. This policy, it feels, will strengthen the country's economy.

Under these conditions, Grace expects its new process to be turning out some 550 tons of bagasse-derived paper per day by 1960.

### Burning upgrades phosphate rock

San Francisco Chemical plans to build a new mill at Leefe, Wyo., to use a recently proved method of upgrading and purifying low-grade phosphate rock.

Crushed rock is sent to rotary kilns and set afire. Hydrocarbons in the rock burn off leaving an ash that contains a higher percentage of  $P_2O_5$  than the original rock. Ash is then processed like high-grade rock. Burning off the hydrocarbons also produces a clearer acid.

The method is limited to western rock deposits and not all of these require such treatment. Anaconda's plants in Idaho calcine rock to drive off hydrocarbons and give a clearer acid but its rock will not support combustion and it doesn't calcine primarily to upgrade the  $P_2O_5$  content as San Francisco does.

### "Ten tons of coal an hour saved"

With stark necessity a prod and clever engineering a tool, Great Britain has built the world's first large-scale nuclear power station. The graphite-moderated, gas-cooled, natural-uranium-fueled reactor (see p. 114) is the first of 12 commercial power reactors which Britain's Central Electric Authority will build by 1965.

Headline in a London paper on the day Queen Elizabeth threw the switch connecting

atomic power to the national grid told much of the story behind Britain's reactor program. "Ten Tons of Coal an Hour Saved," it said, a reminder that Britain is not only running out of coal but is also hard put for dollars with which to buy coal from the U. S. Last year something like \$105 million went for these imports.

As the head of the British Atomic Energy Authority has said recently: "There were compelling reasons leading us to work out the program when we did. They were economic reasons. They did not spring from any unique or spectacular advance in nuclear technology."

But great as the need for nuclear power was, Britain's first nuclear power could not compete with power from modern coal-fired plants without heavy credit for plutonium, the main reactor product. (In future designs power generation will be the prime objective.) Some months ago, British engineers expected their nuclear power to cost about twice that from coal, but technical refinements in reactor design and operation are reported to have cut costs considerably.

Differences in accounting practices, particularly in handling depreciation charges, make it difficult to determine what this power cost would be in the U. S., but some experts figure it at 10-12 mills/kwh. In Britain, top officials predict that by 1965 they'll have atomic power costs lower than the costs of power from coal.

With less pressing economic incentives, atomic power-plant development has been somewhat slower in the U. S.—or, more accurately, the emphasis has been placed on different aspects of development. AEC now has research and development programs on eight reactor types underway in an effort to have ready the most advanced design when our economic pressures pinch like Britain's do now.

Significantly, the just-added eighth reactor on the AEC program involves the gas-cooled concept used by the British—and by the Russians. High capital costs of these reactors has cooled U. S. interest, until now. This was less of a deterrent to the British, who use lower depreciation rates in charging off these costs. Its no deterrent at all to the Russians, who just don't count capital costs in their non-capitalist economy.

For more of WHAT'S HAPPENING . . . . . 114





## 100<sup>th</sup> Anniversary

One hundred years ago, chemists August Cahours and August Wilhelm Von Hofmann published a method for producing allyl alcohol. They considered their discovery merely a laboratory curiosity and foresaw no useful applications for it.

From this humble beginning, however, allyl alcohol has grown into an adaptable

chemical, finding ever-increasing application in industry and agriculture. Today, allyl alcohol is used in the manufacture of such products as resins, weed killers and flavorings.

Shell Chemical pioneered in the production of high-purity allyl alcohol and allyl chloride. Both chemicals are avail-

able, in drum to tank-car quantities, at conveniently located Shell Chemical distribution centers.

Your Shell Chemical sales representative will be glad to help you explore the possibilities of allyl alcohol and allyl chloride in your own operations. *Write for specifications and quotations.*



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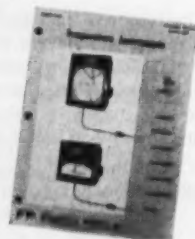
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# What's Happening

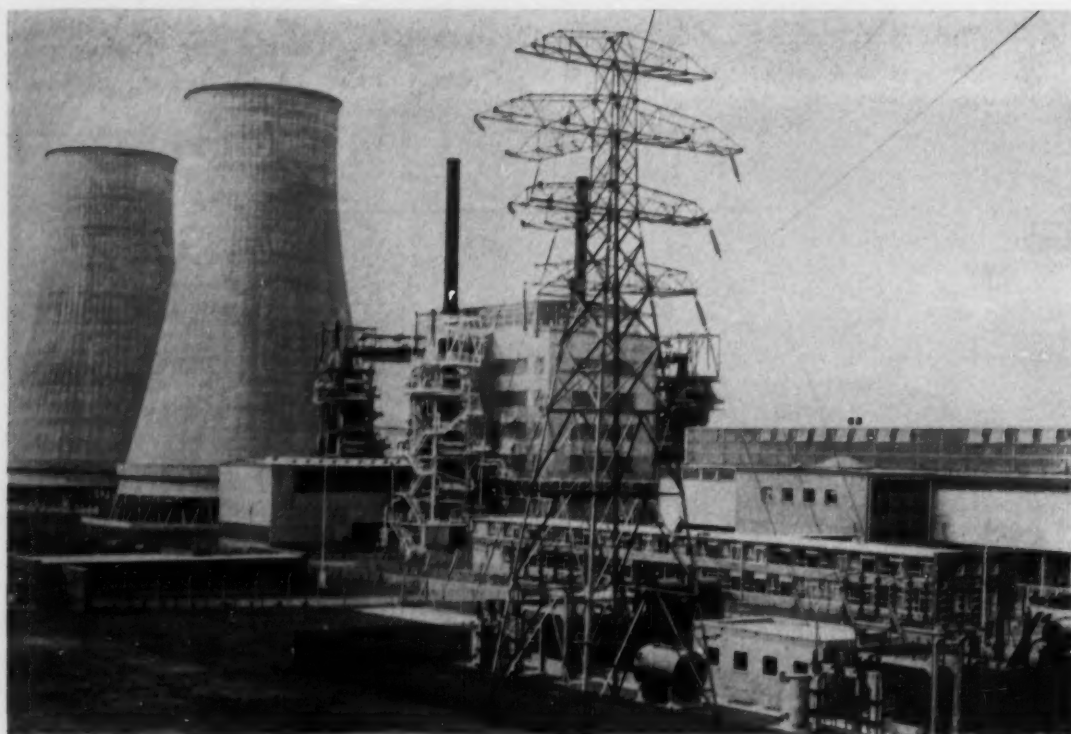
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DECEMBER 1956

FEATURE NEWS

- **Large-Scale Atomic Power Makes Its Debut . . . . . 114**  
Britain's 92,000-kw. Calder Hall station is now in operation; graphite-moderated reactors transfer heat to steam generators via carbon dioxide coolant stream.
- **Giant Electrodes Power Big Furnace . . . . . 120**  
Shea Chemical boosts output of elemental phosphorus with new 45,000-kva. electric furnace, featuring three 45-in.-dia. graphite electrodes.
- **Australia Embraces Chemical Technology . . . . . 124**
- **Liquids Set New Patterns . . . . . 126**  
Striking gains in use of liquid fertilizers for direct application have prompted chemical companies to set up new production and distribution programs.
- **Mills Grind Slow But Fine . . . . . 132**  
New shape of liner, reduced speed of rotation key successful application of ball mills to grinding of spongy Florida phosphate rock.
- **How You Can Save With Digital Computers . . . . . 136**  
Du Pont study of computation costs points up the high cost of plug-board preparation, suggests general-purpose plug-board to reduce over-all costs.
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## Large-Scale Atomic Power Makes Its Debut

**Britain's 92,000-kw. Calder Hall station is now in operation; graphite-moderated reactors transfer heat to steam generators via carbon dioxide coolant stream.**

The United Kingdom, spurred largely by her pressing need for new, reliable power sources, has moved out front in civilization's march to the bright future of the peaceful atom. On October 17 Queen Elizabeth II unveiled the world's first full-scale atomic power plant—the Calder Hall electrical station at Sellafield, Cumberland, England, seen in the accompanying photographs.

Her Majesty's act signaled on stream the first of two graphite-moderated, carbon dioxide-cooled nuclear reactors, harnessed to feed heat to a conventional steam-turbine generating plant. The second pile goes critical in early 1957.

When it does Calder Hall will channel 92,000 kw. of electricity to homes and factories of the island empire.

Sir Christopher Hinton of the U. K. Atomic Energy Authority (builder and operator of the station), figuring in the value reaped from the reactors' co-product, plutonium, estimates the cost of generating this energy slightly below 7 mills/kwh.

► **Gas-Cooling Lineup**—Calder Hall has the first two of 16 power reactors (to produce some 2 million kw. of electricity) scheduled to dot the English countryside by 1965. Hinton reports that the next ten will probably continue to be gas-cooled types, while the final

four may switch to liquid cooling.

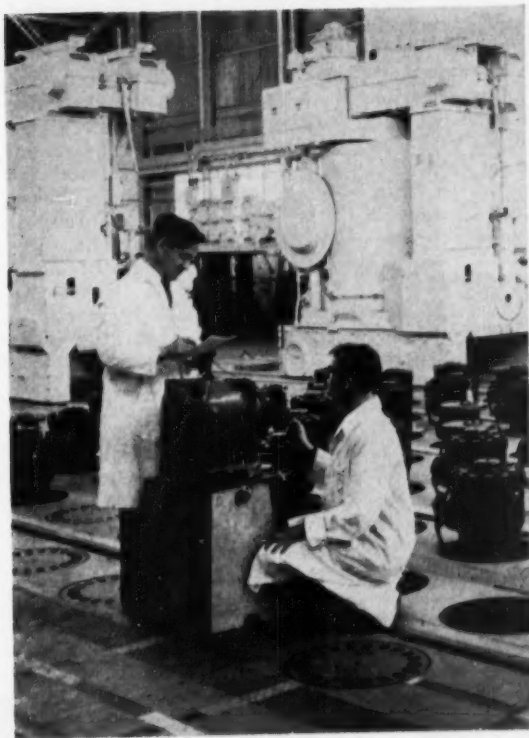
In staying firmly with the gas-cooled unit for the time being, the UKAEA elected an atomic reactor little regarded and hardly developed outside of England. But, as Hinton explains, it answers the special British needs better than, say, any of the U.S.'s favored liquid-cooled prototypes (see feature report, this issue, pp. 191-210). Here's why:

- Inherently stabler and safer to operate than others, the gas-cooled reactor thus does not require a large exclusion area, not easily found in small, highly populated Britain.

- Using natural uranium fuel and carbon dioxide coolant, the gas-cooled reactor does not require unusual and costly materials of construction to prevent crippling corrosion.

► **A Key Drawback**—But a

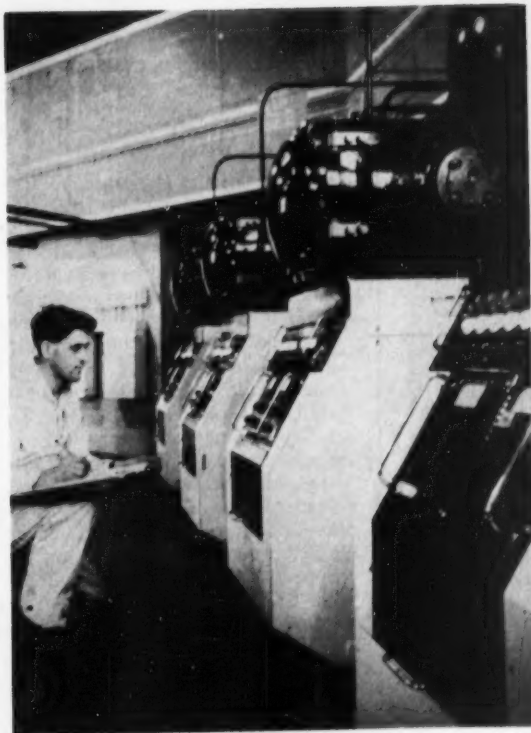




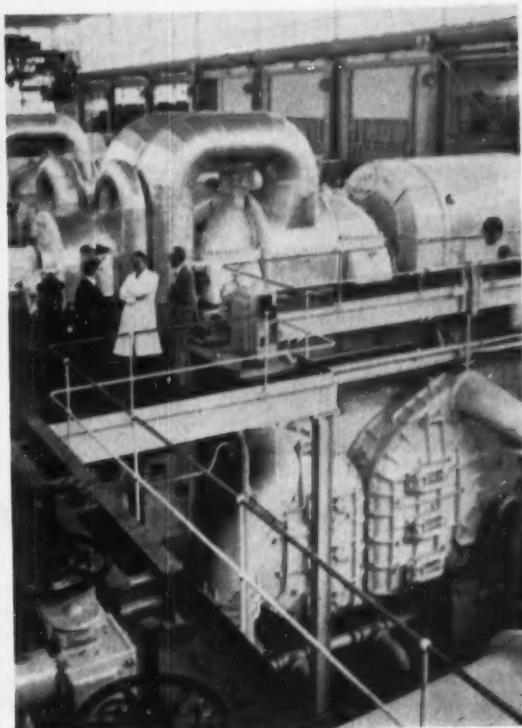
**REACTOR**



**REACTOR CONTROL ROOM**



**GAS SNIFFERS**



**TURBOGENERATORS**



potent argument against this reactor type exists. It can be designed only for moderate power output.

The high-density reaction mass is contained in a cylindrically shaped pressure vessel called the core. Increasing power production from the reactor means fabricating a larger and sturdier pressure vessel to accommodate a very heavy and bulky reaction mass. This poses tough design and materials problems that sharply limit the top size vessel possible, thus restricts size of reaction mass and power output.

At Calder Hall the pressure vessels, fabricated from 2-in. welded steel plate, stand 60 ft. high by 40 ft. dia. They hold some 1,000 tons of reaction mass on hefty A-frames and I-beams.

► **How Pile Works**—The reaction mass consists of a stack of machined graphite blocks (moderator) fitted with 1,500 vertical channels for uranium charge (fuel) and boron steel control rods. A steel plate, then an octagonally shaped concrete shield, surround the reactor core vessel. Cooling air passes between the steel and concrete shields.

Withdrawing the control rods swings the reactor on stream. As the reaction uses up the uranium, the spent slugs are replaced and plutonium recovered.

Carbon dioxide, generated from dry ice, sweeps into the bottom of the pressure vessel via four single-stage, centrifugal blowers. Passing through the fuel channels, the gas car-

ries out the heat of the reaction from the top of the vessel to four heat exchangers.

► **Making the Electricity**—Hot CO<sub>2</sub> passes down the shell side of the exchangers; recirculated condensate from the steam-turbine plant pours through the tubes. Each exchanger, housed in a vertical steel pressure shell 70 ft. high by 18 ft. dia., provides 30,000 sq. ft. of heat-transfer surface. Cooled CO<sub>2</sub> recirculates to the reactor core.

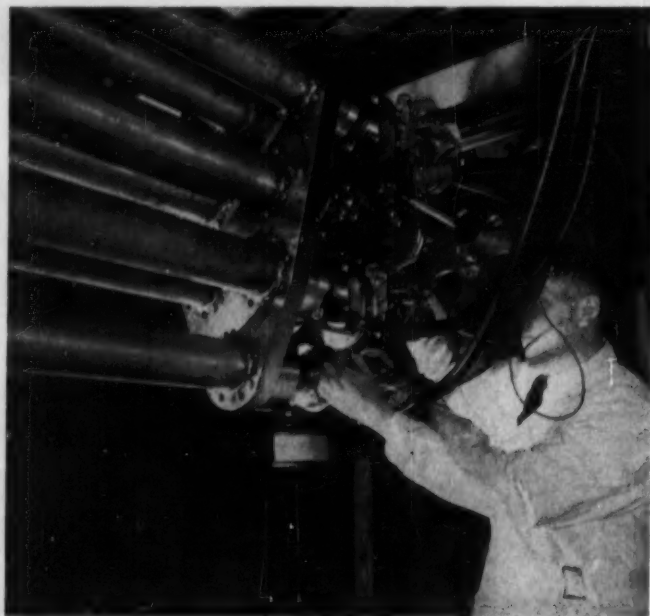
A "sniffer" apparatus takes gas samples from each of the 1,500 fuel channels every 30 min. and monitors the radiation level. If the level is abnormally high, a warning sounds in the control room and its cause (e.g., punctured fuel element) is hunted down swiftly. A constant check is also kept on the gas stream's water content and graphite-dust accumulation.

Steam produced in the heat exchangers feeds to four 23,000-kw. turbogenerators. (With just one pile on stream right now only two of the generators are operating.) Exhaust steam from the turbines is condensed by cooling water which is recirculated through two 290-ft.-high by 220-ft.-dia. cooling towers. The condensate then returns to the heat exchangers.

### Trio of Developments In Synthetic Rubbers

Esso Research and Engineering has announced that it is commercially practical to make automobile tires entirely of synthetic rubber through the use of a butyl latex which the company has perfected. And Firestone states that its man-made natural rubber (*Chem. Eng.*, Dec. 1955, p. 108) has been successfully tested by Army Ordnance on all-synthetic military truck tires. In foam rubber, B. F. Goodrich has developed a "freeze agglomeration" process said to turn out an improved, high-solids-content latex 2½ times as fast as conventional methods.

Esso's butyl is said to give a smoother ride and cut down tire-squealing on curves because it absorbs vibrations to a greater degree than conventional styrene



### Rod Mechanism Controls New Nuclear Test Reactor

Alco Products, Inc., has opened a new nuclear criticality facility at Schenectady, N. Y. It performs experimental reactor studies to check calculations vs. actual reactor performance. Reactor room is 40 by 30 ft.

and 30 ft. high, housing a 2,500-gal. unpressurized reactor water tank. Heart of the reactor's control system is the drive shown above, used to move control rods from a remote station, thus controlling the nuclear output.



R. CAMPBELL  
Telephone Building  
1710 WEST FIFTH AVENUE  
VANCOUVER 9, B.C.

June 20, 1956

D. Fulton, Esq.,  
Vice President,  
The Lummus Company Canada Limited,  
455, Craig Street, West  
Montreal, P.Q.

Dear Mr. Fulton,

It is a pleasure to write to you of the satisfactory operation of the Sulphuric Acid plant at Fort Saskatchewan, Alberta, which your company built for Inland Chemicals Canada Limited last year. The plant is performing successfully, producing specification products over the designed capacity range, even during severe winter conditions such as we had in 1955/1956. The operating costs experienced to date confirm the efficiency of the plant.

We were impressed with the short construction and installation period used by your company, especially since the project was started during difficult climatic conditions early last year. It was also gratifying to see the plant start up and go on stream effectively and without encountering difficulties.

Please extend our thanks to the members of your organization who were engaged on this project.

Yours very truly,

R. Campbell  
R. Campbell  
President  
Inland Chemicals Canada Ltd.

100-ton per day plant built by Lummus for Inland Chemicals Canada Limited went onstream 9½ months after the contract was signed, 7 months after field work began.

This sulfuric acid plant was—

*Finished fast...  
started smoothly...  
is going fine!*

Winter is rugged at Fort Saskatchewan, Alberta. In spite of it, this \$1,000,000 sulfuric acid plant built there by Lummus was completed well ahead of schedule, and was making specification product within 12 hours of startup.

That was a year ago. Since then this plant has been producing to specification over a range of capacities from 45 to 125% of design.

Why not talk to Lummus before you start your next project?

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y.  
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Paris, The Hague, Bombay.  
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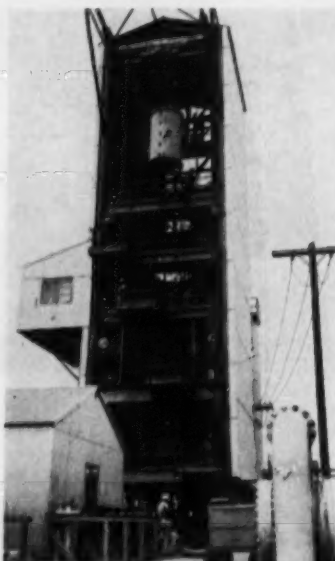
ENGINEERS AND CONSTRUCTORS FOR INDUSTRY



rubber. Test marketing will begin soon; prices will be on a premium-tire level.

In the area of heat buildup, which may be one of butyl's remaining weaknesses, Firestone's man-made natural is said to excel. It withstands the intense temperatures generated by truck tires carrying heavy loads for long distances as well or better than natural rubber.

The Goodrich latex, especially suited for such end products as foam rubber upholstery and bedding, is expected to cost manufacturers 25¢/lb., compared with 28 to 35¢ for latex made by present methods.



### Air, Not Oil, Feeds Big Gasoline Pilot Unit

Five stories high, Esso's newest and biggest pilot plant has started operating in Linden, N. J., to supplement laboratory-scale studies of the fluidized-solids technique of making gasoline.

Compressed air, sometimes tinged with trace quantities of helium, serves adequately as a substitute for oil feedstocks, since the unit is aimed specifically at engineering research rather than process research. It flows through at a rate of 8,000 cfm. The powdered catalyst in the fluidized bed is of the same type as that used in commercial

refining units. Three hoppers supply three different types of solid catalyst.

The reactor is built in six 2-ton sections, any number of which can be removed to allow engineers to make experimental changes inside the vessel. A 5-ton crane mounted at the top of the unit is used to lift sections in and out of position.

More than 200 stoppered port-holes stud the huge reactor. Through them, samples of air can be removed for analysis while the plant is on stream.

### Diamond Further Defines Four-Year Expansion

Diamond Alkali has announced plans to build a \$10-million, 40-ton/day acetylene plant in Houston plus a 200-ton/day chlorine expansion there.

Part of a four-year (1956 through 1960), \$60- to \$80-million program, the company has already started expansions in perchlorethylene, polyvinyl chloride, cement and soda ash.

Initially, new acetylene output will be used in making vinyl chloride monomer, capitalizing on availability of byproduct hydrochloric acid from other chlorinated products operations.

### Frasch Approach To Trona Mining

Intermountain Chemical Co. has leased state-owned lands in Sweetwater County, Wyo., to test the feasibility of fluid mining of trona. Operations will be similar to those often used in sulfur or salt mining.

Intermountain plans to heat a chemical preparation and inject it 1,500 ft. under the ground under extremely high pressure. Fluid would dissolve the trona, which would then come to the surface of the chemical reservoir. Brine would then be processed to solidify the trona for further processing at the company's Westvaco, Wyo., soda ash plant. Wells-to-plant piping has already been installed.

However, Plant Manager C. V. Romano says that underground

behavior, chemical impurities and operating difficulties may mean that it will be several years before the method can be used on a practical basis. The company tried the idea out about ten years ago, then abandoned it. But refinements on the process may now make it feasible.

### Convention Calendar

**Society for Applied Spectroscopy**, regular meeting, discussion on spectroscopy in inorganic chemistry, Hotel New Yorker, New York, Dec. 4.

**Society of the Plastics Industry**, Seventh Film, Sheet and Coated Fabrics Div. Conference, Commodore Hotel, New York, Dec. 4-5.

**American Institute of Chemical Engineers**, annual meeting, includes symposia on low-temperature processing, advancing automatic control of chemical processing plants, Statler Hotel, Boston, Dec. 9-12.

**Society of Plastics Engineers**, 13th Annual National Technical Conference, St. Louis Section, "Fifteen Years of Plastics Progress," Sheraton-Jefferson Hotel, St. Louis, Jan. 16-18.

**Association for Applied Solar Energy**, in conjunction with Arizona State College and University of Arizona, symposium on solar furnace design and operation, Hotel Westward Ho, Phoenix, Jan. 21-22.

**Canadian Pulp and Paper Association**, annual meeting, symposia on all phases of pulp and paper manufacture, Mount Royal Hotel, Montreal, Jan. 23-25.

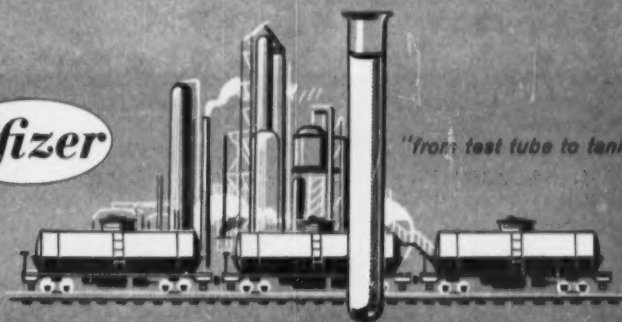
**Eighth Plant Maintenance & Engineering Conference**, concurrently with Plant Maintenance & Engineering Show, Public Auditorium, Cleveland, Jan. 28-31.

**American Welding Society**, Midwest Welding Conference, Chicago Section with Armour Research Foundation, Illinois Tech Chemistry Bldg., Chicago, Jan. 30-31.



product news from

**Pfizer**



## VERSATILE ORGANIC ACIDS AVAILABLE IN QUANTITY

● When Pfizer opened the world's first successful citric acid fermentation plant in 1923, the world price of citric dropped more than two-thirds! Since that time Pfizer leadership in fermentation chemistry has made many other useful acids available to industry in quantity.

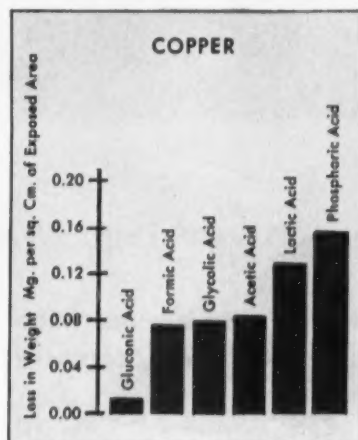
### CITRIC ACID

Pfizer offers citric acid in both anhydrous and hydrous forms. With Pfizer's anhydrous form of citric acid, you save money in reduced freight costs. Why pay freight for 8½ lbs. of water per each 100 lbs. of citric shipped? In addition the anhydrous form offers the advantage of ideal quality control since there is little or no variation in moisture content.

Citric acid is a relatively strong acid notable for its nontoxicity, its sequestering ability and the number of chemical reactions it will undergo. Pfizer also offers citric acid salts and five esters in commercial quantities. These are Triethyl and Tributyl Citrates as well as their acetylated forms. Acetyl tri-2-ethylhexyl citrate is also available.

### GLUCONIC ACID

By the fermentative oxidation of glucose, Pfizer produces gluconic acid, which it offers as a 50 percent aqueous solution and in the form of stable salts. Gluconic acid has a low order of toxicity, is extremely mild and non-corrosive and has excellent sequestering properties. Tests at Pfizer have shown that 1N gluconic acid solutions affected metals less than any of five other mild acids. Consider copper for example:



### OXALIC ACID

Pfizer developed a fermentation process which yields oxalic acid in a high degree of purity. One of the

outstanding features of this strong acid is its ability to solubilize iron oxide. Pfizer Oxalic Acid is available in granular and fine granular forms. Ammonium, ferric ammonium, ferric and other oxalates are also available.

### TARTARIC ACID

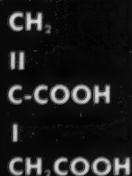
Crystalline deposits in wine fermentation vats provided the raw material from which Pfizer began producing high purity tartaric acid in 1862. Like citric and gluconic acids, tartaric acid is notable for its low toxicity and its sequestering activity.

### ITACONIC ACID

Pfizer skill in fermentation has made industrial itaconic acid a reality. Two carboxyl groups, a conjugated double bond and an active methylene group make itaconic acid a reactive and versatile molecule. Itaconic esters, readily prepared in high yields, can be polymerized and may serve as useful plasticizers. Polyesters of itaconic acid and glycols may be polymerized or copolymerized to hard thermoset resins.

You can order versatile **PFIZER ORGANIC ACIDS** in large tonnages. If you want further information on any of them, write us outlining the type of application you are considering. Pfizer Technical Service can help you with extensive data on organic acids.

### PHYSICAL PROPERTIES OF ITACONIC ACID



Formula	H <sub>2</sub> C <sub>3</sub> H <sub>4</sub> O <sub>4</sub>
Molecular Wgt.	130.10
Appearance	white crystalline powder
Melting Point	167-8°C
Solubility in Water	
At 20°C.	8.3 Gm./100 ml.
At 80°C.	72.5 Gm./100 ml.

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## Giant Electrodes Power Big Furnace

**Shea Chemical boosts output of elemental phosphorus with new 45,000-kva. electric furnace, featuring three 45-in.-dia. graphite electrodes.**

The electric furnace you see above is believed by Shea Chemical Corp. to be the largest in the phosphorus industry. Rated at 25,000 tons/yr. of elemental phosphorus and supplied with 45,000 kva. of power, the new furnace started operating at Shea's Columbia (Tenn.) plant in September.

The big furnace cost a total of \$2.4 million, of which \$1.4 million represents the cost of the furnace itself and \$1.0 million went for handling equipment. It raises Shea's phosphorus production capacity at Columbia to 45,000 tons/yr.

► **Playing Leap Frog**—Shea isn't a bit backward about tack-

ling big jobs. When the firm entered the elemental phosphorus field in 1953, it did so with a 34,000-kw. furnace which, at that time, was claimed to be the "world's largest" (*Chem. Eng.*, Oct. 1953, pp. 116-117).

Early this year Shea's claim was nullified by publication of data which indicated that Westvaco's No. 4 furnace at Pocatello, Ida., was rated at 36,000 kw. and believed by Westvaco to be the "largest elemental phosphorus furnace now operating." Westvaco's carefully worded statement acknowledged the fact that Shea's No. 2 furnace, then under construction, would

soon regain for Shea whatever distinction goes with having the biggest phosphorus furnace in captivity.

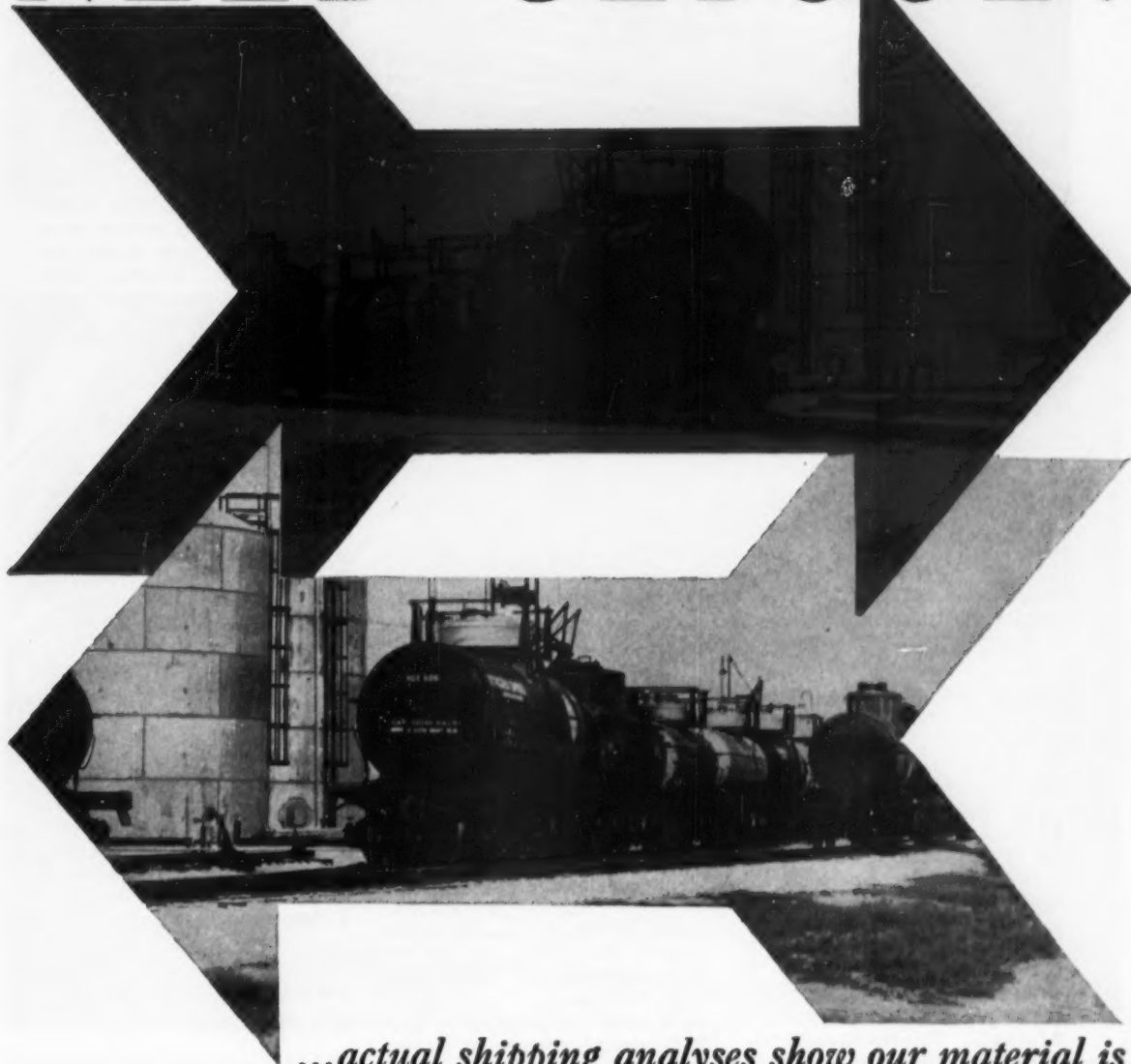
► **Giant Electrodes**—Shea's new furnace uses three 45-in.-dia. graphite electrodes spaced in line on 9½-ft. centers. Each electrode is made up of three 108-in. sections screwed together with graphite pins.

According to National Carbon Co. (whose electrode plant at Columbia is within sight of Shea's phosphorus plant), the 45-in.-dia. electrodes are the largest graphite electrodes made. The fact that National began making them during 1955—many months before Shea needed them—might indicate that National is shipping them to other phosphorus furnace operators as well.

The question of whose furnace is "largest" is actually



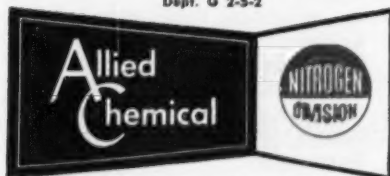
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At our Orange, Texas plant — one of the world's most modern petrochemicals plants — we employ the most advanced processes to turn out ethylene, diethylene and triethylene glycol of the highest commercial purity. They are available in bulk from the plant in 4, 6, 8 and 10,000-gallon tank cars or barges — and in L.C.L. shipments (drums or tank trucks) from Edgewater, N. J.; New York, N. Y.; Boston; Chicago; Los Angeles; and other key industrial points.

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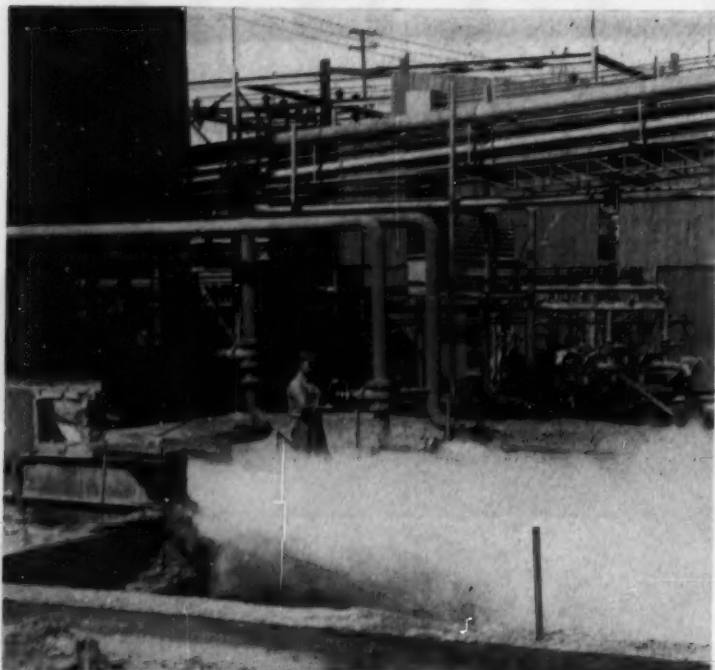


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Ethanolamines • Ethylene Oxide • Ethylene Glycols • Urea • Formaldehyde • U. P. Concentrate—85 • Anhydrous Ammonia • Ammonia Liquor • Ammonium Sulfate • Sodium Nitrate • Methanol • Nitrogen Tetroxide • Nitrogen Solutions • Fertilizers & Feed Supplements





STEAM CLOUDS arise when molten slag is granulated in jets of water.

more a matter of power input than physical dimensions of the furnace shell. In fact, Shea's No. 1 furnace originally operated at only 26,000 kw. while using 40-in.-dia. carbon electrodes. Shea soon converted it to 35-in. graphite electrodes (graphite has a much higher conductivity than carbon), hiked operating limit to 34,000 kw.

Now under way is another conversion project for No. 1 furnace which will bring it up to the capacity of the new No. 2 furnace. This involves installation of a larger transformer and bigger electrodes. By January 1 Shea expects to be turning out phosphorus at a 50,000-ton/yr. clip.

**► Advanced Engineering** — Shea's engineers were not content merely with the labor and overhead savings of the big furnace. The new installation also boasts these features:

- A different type of copper bus bar from transformer to furnace requires less copper and gives greater power efficiency. This is done by forming the delta on the electrode rather than in a copper bundle in the rear of the furnace.

- A Koppers electrostatic precipitator—first use of this device on a phosphorus furnace—is expected to be as efficient as other precipitators in common use at a first cost 35-50% less and with lower maintenance cost. The Koppers design consists of concentric tubes with the discharge wires suspended in the annular space between the tubes.

**► Granulated Slag**—Molten slag from the furnace is granulated to 6 mesh by pouring it into high-velocity streams of water. This system requires a pump and a ½-mile pipeline and replaces trucks and shovels formerly used to remove slag.

Big advantage of the new system is due to the large quantity of slag that must be moved continuously. When both furnaces are running, they discharge 1,000 tons/day of slag.

Shea's engineers have also developed a technique to use by-product carbon monoxide from the furnaces exclusively in operation of any one of its three nodulizing kilns. Normally some other fuel must be used in conjunction with the CO. Fuel value of the CO thus utilized

amounts to \$12,000-15,000 per month.

**► Where It Goes**—Enlargement of phosphorus-production capacity at Columbia permits Shea to double its production of sodium phosphate and add a third to its phosphoric acid capacity. Facilities for making these two products are just being completed at a new plant in Dallas, Tex., and a new sodium phosphate plant is now under construction at Adams, Mass. These units supplement older facilities at Columbia, Adams, and Jeffersonville, Ind.

### More Styrene for U.K., Less for U. S.

A \$4.9-million styrene monomer plant is to be built at Partington, England, by Petrochemicals, Ltd., an associate of Shell Chemical. To be completed by 1958, the plant will ship most of its output to Styrene Products, Ltd., a Petrochemicals subsidiary, for the production of polystyrene molding powders.

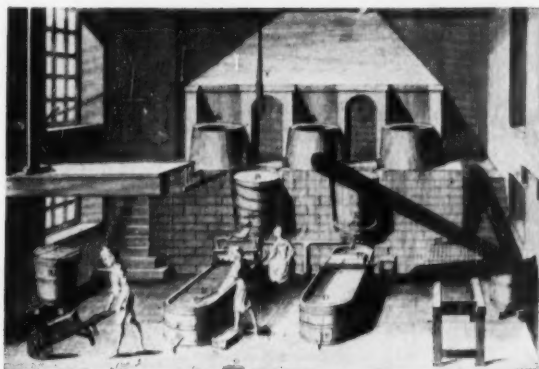
Firestone Tire & Rubber has abandoned plans for an announced styrene plant in Orange, Tex., because of a substantial reduction in the price of styrene on long-term contracts by present producers. Price has come down from 16¢ to 12¢/lb. Construction work is continuing at Orange on a plant to make butadiene.

### Two Expansions Set For Methanol

Commercial Solvents has announced a substantial expansion of its methanol purification facilities at Sterlington, La., and Escambia Chemical plans a methanol plant near Pensacola, Fla., to make 12-20 million gal./yr.

Reichhold Chemicals has signed a long-term contract under which it will buy a large part of Escambia's production for conversion to formaldehyde. A second agreement recently made by Reichhold which marks its entry into another field: A nonexclusive epoxy resin patent license for the United States and Canada granted by Devoe & Raynolds.





## Important new things are happening to waxes



Wax, almost as old as civilization itself, is now being remarkably upgraded and improved by combining it with the newest of polymers, A-C POLYETHYLENE. This low-molecular-weight, low-viscosity polyethylene easily and economically up-grades both paraffin and microcrystalline waxes, replaces costly vegetable waxes.

Because A-C POLYETHYLENE handles as easily as wax, there's no need to change processing methods... you can blend it on all conventional

equipment whether for hot melt or emulsification processes. And, A-C POLYETHYLENE is low in cost, uniform in supply and quality.

### Added to waxes, A-C Polyethylene improves:

blocking	gloss	scuff resistance
color intensity	hardness	water resistance
coverage	mileage	tensile strength

### Further, A-C Polyethylene helps:

- decrease slip
- reduce bulging and leaking in dairy cartons
- aid weatherproofness of building materials
- protect yarns and fibers in textiles and paper

Check this list for industry-proved applications of A-C Polyethylene; then investigate its advantages in your formulations:

Asbestos shingles	Leather
Bottle cap liners	Linoleum
Boxboard containers	Metal powder lubricants
Candles	Paints, lacquers and varnishes
Carbon paper	Paper, coating, laminating and sizing
Color dispersants	Pharmaceuticals
Cosmetics	Plastics
Crayons	Polishes, liquid and paste
Dairy cartons	Potting compounds
Fibre drums and cups	Printing ink
Fruit and vegetable coatings	Textile size
Glass bottle coatings	Tile, asphalt, cork and rubber
Industrial coatings	Wax blending
Insecticide spray	Wire and cable
Investment waxes	

Write on your letterhead advising us of intended use. We will send you data sheets and samples of the appropriate grades of A-C POLYETHYLENE.

# *A-C Polyethylene*

**SEMET-SOLVAY PETROCHEMICAL DIVISION**

Allied Chemical & Dye Corporation

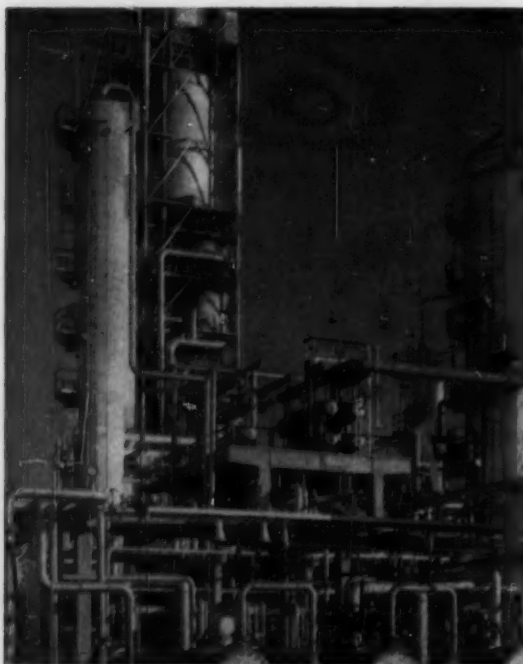
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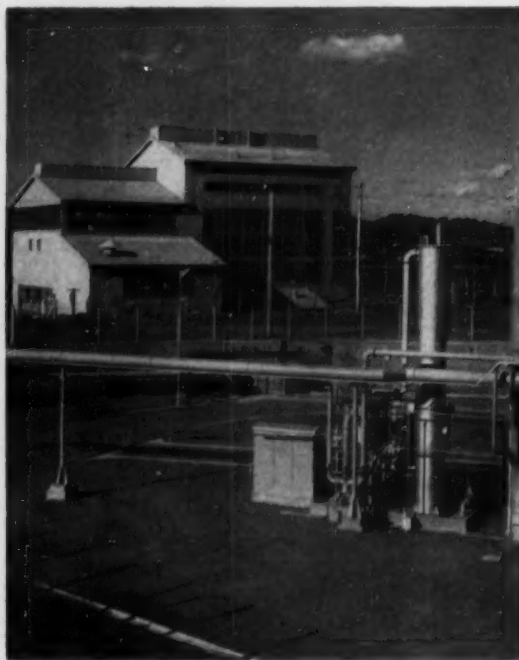
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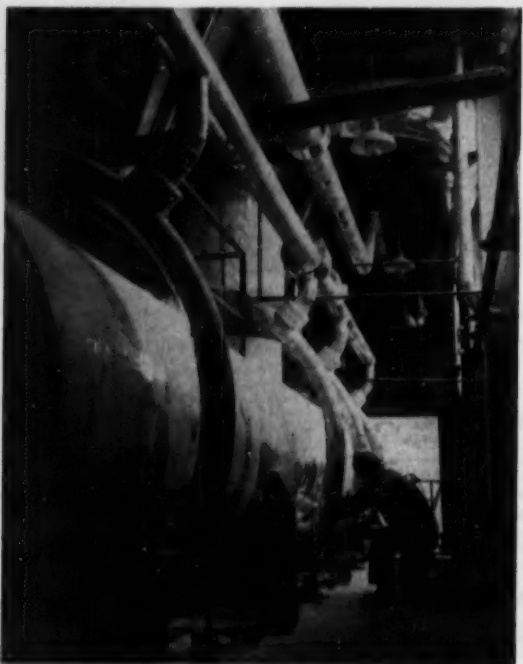
## Australia Embraces Chemical Technology



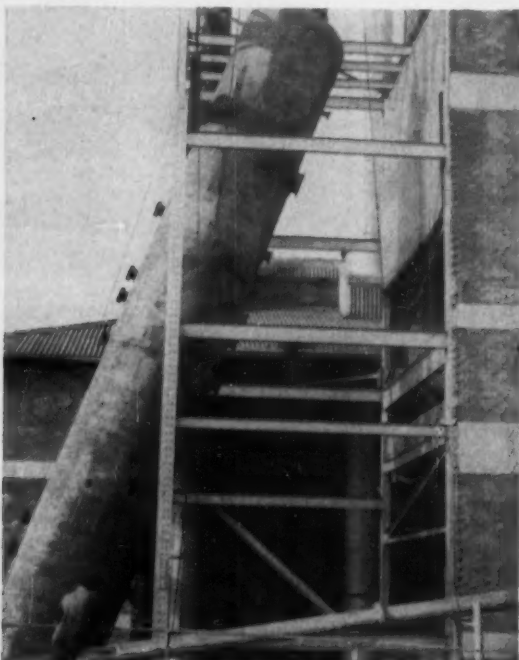
**AVIATION GAS** Standard Vacuum's two-year-old catalytic cracking unit at Altona, Victoria, was nation's first for aviation gas.



**FERTILIZER** Newest unit in Electrolytic Zinc's big sulfur-utilization works at Risdon is this 55,000-ton/yr. ammonium sulfate plant.



**ACETATE** Steam-vacuum drier at C.S.R. Chemical's Sydney plant, cellulose acetate adds to chemical industry's 1.83% of nation's output.



**WOOD PULP** World's first continuous digester using eucalyptus hardwood has started at Associated Pulp & Paper's Burnie mill.



# tall oil

*... another example of*  
**FRACTIONATION KNOW-HOW**

**By Foster Wheeler**

**T**his new tall oil fractionation unit, designed and constructed by Foster Wheeler for Union Bag-Camp Paper Corporation's Savannah, Ga., plant, is now "on stream", producing fatty acids and rosin of high purity.

In operation and producing within 13 months after date of final authorization, this modern, efficient vacuum fractionating unit separates 1,500 to 2,000 tons of tall oil per month into rosin and fatty acids, of better-than-guarantee specifications.

Working in close cooperation with customers' engineers, Foster Wheeler can design and construct fractionation units to meet specified quality and quantity requirements for the processing of many types of feed materials. For further information or a complete description of this plant, write to Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.



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IN FERTILIZER MANUFACTURE . . .



. . . AND FERTILIZER DISTRIBUTION

## Liquids Set New Patterns

Striking percentage gains in the use of liquid fertilizers for direct application have been scored every year since their commercial inception less than a decade ago.

Though still small in the over-all fertilizer picture, liquid fertilizers—low-pressure and non-pressure nitrogen solutions and complete neutral mixes—

have made enough splash with their rising consumption to send ripples throughout the fertilizer industry itself and its chemical, equipment and other tributaries.

Indiana farmers, typical of those in the Midwest (which is second only to the West Coast market for liquid fertilizers), have doubled their consumption

of complete neutral solutions in each of the four years since these products became commercially available in the region. Consumption in the state rose from 6,697 tons in the 1954-55 season to 11,988 tons in the fertilizer year just past.

← Looking more like a tank farm for petroleum products than a fertilizer plant is this liquid fertilizer mixing plant at Lawrence, Kan. Here, Kaw Fertilizer Service produces complete neutral solutions.

In California, neutral solutions expanded 92% during the first half of 1955. Aqua ammonia rose 78%, actually nosing out dry fertilizer mixtures in the second quarter.

► **Small But Impressive**—Even in these *avant-garde* areas, however, consumption of complete solutions, compared with total fertilizer consumption, now amounts to only 1-2% in the Midwest, about 9% on the West Coast.

Nonetheless, consumption jumps have been significant enough to:

- Prompt many of the fertilizer industry's suppliers of basic chemicals—companies like Shell, Brea, American Cyanamid, Allied, Monsanto, Davison, Sohio—to set up production and distribution programs aimed at the new market.

← Here's how Brea Chemicals' aqua ammonia reaches the ultimate consumer.

- Demand quarter in the long-range planning of other vendors to the fertilizer trade, not only chemical and equipment firms whose output may be rechannelled or increased by the growth of liquids but those, like paper bag manufacturers, whose markets the liquids may curtail.

- Mount up a total of about 150 companies producing liquid fertilizers of one kind or another. Some are basic chemicals producers feeling their way into the new field. Mostly, however, they are local independent formulators, with an average plant output of 1,000 tons/yr. compared with the 20,000-ton/yr. average for dry-fertilizer formulators.

► **Fluid Charms**—Basic reasons



## ENGINEERING DEPT.—SUMMARY REPORT

To: T.M.D. Vice Pres., Production

From: R.R.G. Chief Engr., Inorganics

SUBJECT: Test Program—Sharples Super-D-Hydrator, caustic soda production.

MATERIAL: Slurry from double effect evaporator taken from second effect underflow at 25% sodium hydroxide concentration.

OBJECTIVE: a. Recovery of sodium chloride crystals with minimum entrained caustic.  
b. Reduction of sodium sulphate content of sodium chloride crystals by use of brine rinse.

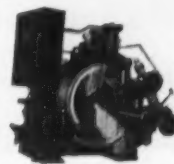
RESULTS: Production runs were made on a C-27 Super-D-Hydrator under controlled conditions of application of cell liquor, water, and saturated brine rinses.

At a capacity of 4.50 tons of salt per hour, using 0.1 lbs. of rinse water per lb., and 0.7 lbs. of brine per lb. of salt, the salt crystals were discharged at 0.1% NaOH content with less than 0.6% sodium sulphate.

ACTION: The sulphate-laden brine rinse was automatically kept separate from the mother liquor and the valuable alkali-bearing rinse liquor.

Immediate recommendation of the purchase of four C-27 Super-D-Hydrators to meet our existing requirements. This same equipment will handle 20% expansion when our new source of low sulphate salt goes into production.

The Sharples Super-D-Hydrator produces high purity crystals of very low moisture content at capacities up to 8 tons per hour. Its flexibility and unparalleled performance are recognized throughout industry. We shall be glad to send you a copy of Sharples Bulletin 1257.



# SHARPLES

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behind the interest in liquid fertilizers are the traditional charms of handling liquids and the novelty of their impact on fertilizer users:

- **Quicker to apply**—Tractor-mounted applicators can be used to apply them four times as fast as dry, bulk fertilizers.

- **Labor saving**—Gravity or pumps do the work of transfer; there are no bags to lift or carry.

- **Nonhazardous**—Unlike anhydrous ammonia, which must be kept under pressure, aqueous solutions can be readily handled by the usual farm laborer.

- **Easier to apply**—Low-pressure nitrogen solutions (those containing excess ammonia) can be applied at a depth of only 3 in., compared with 6 in. for anhydrous ammonia. The non-pressure variety (nitrogen solutions containing no free ammonia) and the

complete neutral solutions can even be applied on the surface. Sometimes herbicides and insecticides can also be incorporated into the solution, saving the farmer multiple trips around his fields.

Moreover, use of liquid mixed fertilizer eliminates difficulties with segregation and caking often encountered in shipping and storing solid mixtures.

- **Competitive in Cost**—The liquids sell to the farmer at about the same price per plant-food unit as solids. Higher cost of raw materials and manufacture are offset by lower handling costs. (The formulator often supplies equipment and labor for application of liquids as part of his customer service, at about \$2/ton.)

And because liquids are formulated closer to the market than solids, the comparative transportation costs might be \$3/ton vs. \$15/ton.

- **Merging Markets**—Though most chemical producers feel the field is too new and amorphous to permit any concrete projections of its future growth, the interested ones agree that the solutions' advantages are sturdy enough to earn them a significant piece of the expected growth in fertilizer consumption (from 6.5 million tons of plant food used at present to 14 million in 1965). Dry and liquid fertilizer can each find its place in the same area, they believe. Liquid fertilizer will not replace dry but will continue to take an increasing percentage of future fertilizer sales.

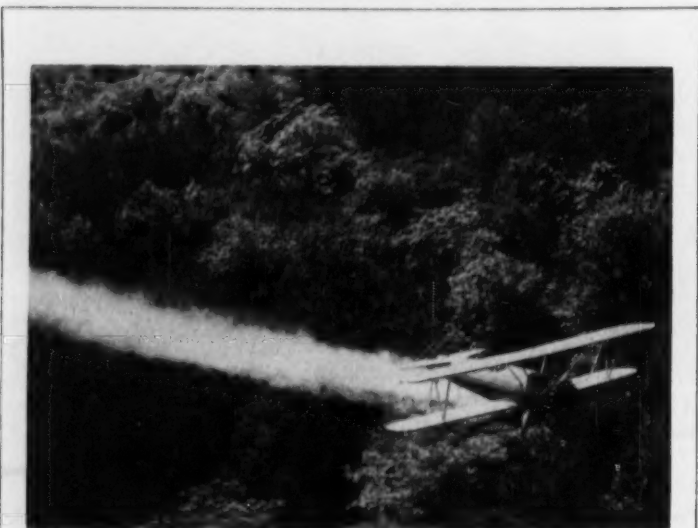
And for a gigantic, uncharted, decade-off market like fertilization of forests and rangelands, the liquids seem peculiarly well suited because of the ease with which they might be applied from aircraft. California rangeland alone could use enough fertilizer to double the state's current total consumption.

West Coast companies like Brea and Shell have not only set up production facilities for liquids but handle their own distribution to key agricultural points, maintaining control of products and their use close to actual point of application. Davison Chemical has set up a 15-ton/hr. complete liquid fertilizer plant, serving part of Indiana and Michigan, to gain marketing know-how.

- **Fertilizer Filling Stations?**—Because of such factors as the need for custom-formulating fertilizers to individual local specifications and the high cost of transporting water in the solutions over distances of more than 50 miles, the nature of the liquid fertilizer business at present seems to demand many small formulators located close to the market.

However, many firms have looked into the idea of a filling-station setup like the oil companies have. At least one serious flaw in the filling station analogy: Gasoline customers pay on receipt of goods; farmers buy fertilizer on credit, their ability to pay depending on the worth of their future crops.

However, this situation is



### Now They're Fertilizing Forests From the Air

Believed to be the first application by air of fertilizer to a forest stand, Rutgers University Dairy Research Farm, Beemer-ville, N. J., has been dusted with 400 lb./acre of a 12-12-12 mixture. Recent tests, which show that the practice increases growth from 40 to 65%, fore-

cast that forests will provide big new markets for fertilizers within a decade or two.

Though solids were used for this pioneer application, new liquid fertilizers discussed in the accompanying article show special promise for this type of broad-scale airborne application.





Left: 12-ft. O.D. by 43-ft. 4-in. digester with 316 E. L.C. Hortonclad. Inset: Interior of vessel built for Hudson Pulp and Paper Co. at Palatka, Florida.

# HORTONCLAD and CB&I VESSELS

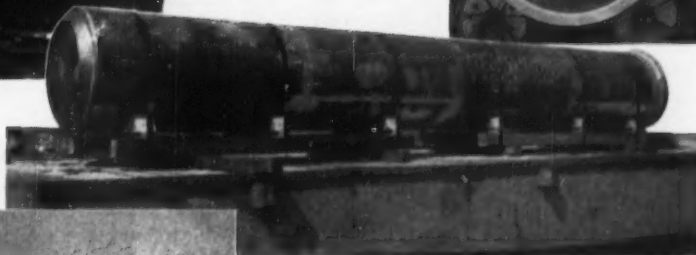
## High Vacuum Brazing Process Assures Uniform Thickness of Clad Layer

Hortonclad®, available only with CB&I process and storage vessels, is a composite metal having an integral and continuous bond produced by a high vacuum brazing process. Uniform thickness is assured as the alloy cladding and the backing are in their final thickness before bonding. Hortonclad meets all ASME Boiler and Pressure Vessel Code and API-ASME Unfired Pressure Vessel Code requirements.

CB&I vessels can be fabricated using Hortonclad plates with silver, monel, Inconel, Hastelloy, stainless and a wide variety of other metals and alloys. Complete information on Hortonclad and its use with CB&I vessels may be obtained by writing our nearest office.



Above: A 36-ft. 9 $\frac{1}{2}$ -in. shell section of this 43-ft. reactor has type 405 stainless steel Hortonclad. Inset: View inside of reactor supplied to the Derby Oil and Gas Co., Wichita, Kansas, through the Fluor Corp.



Above: 37 $\frac{1}{4}$ -in. O.D. by 24-ft. 10 $\frac{1}{2}$ -in. urea autoclave liner with fine silver Hortonclad. Inset: View of interior.

## Chicago Bridge & Iron Company

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subject to change. Ventures one chemical industry spokesman, "If raw materials and processes are developed which require large investments but at the same time permit the production, storage and use of high-analysis, low-cost liquid fertilizer, it would be logical to have a large producing plant feeding outlying storage facilities."

► **Technical Drawbacks**—His statement points up some of the major technical difficulties facing complete liquid fertilizers in particular:

- **Need for high analyses**—In this day of rising demand for high analysis in dry mixed fertilizers, now up to about 15-15-15, the best that complete liquids can do is 10-10-10 before crystallizing out. TVA and others are currently at work on much-needed research into solubility relationships. Higher analyses would also mean lower shipping costs.

- **Need for cheaper raw materials**—Wet-process phosphoric acid cannot be used for making neutral solutions because it causes precipitation. Since it is both cheaper and more plentiful than the electric-furnace product used today, development of ways to use it would give the liquid mixes an important economic boost.

Other drawbacks which the liquids have yet to overcome: Storage, as well as shipping, is expensive; the nitrogen solutions are corrosive.

► **How They're Made**—Manufacturing process for complete liquid fertilizers is relatively simple. The only operation beyond simple mixing is neutralization of the phosphoric acid with ammonia. But there are several points on which both practice and opinion differ. Principal differences are: Batch vs. continuous neutralization; methods of proportioning raw materials; means for preventing ammonia loss during neutralization. Urea and potash are generally added after neutralization.

System chosen as simplest and most effective by Davison Chemicals for its Wakarusa, Ind., plant is offered by Fabricated Metals, Inc., San Leandro,

Calif. It provides for production of aqua ammonia, the ability to cool during the neutralization process and maintenance of the proper balance of ammonia and phosphoric acid by means of a pH meter. Also, a removable plastic bag is used to line the steel phosphoric acid tank, instead of a more expensive rubber lining.

### No Exchanger Shutdown While Ions Regenerated

Chemical engineering team at the University of Tennessee has developed new ion-exchange equipment said to eliminate the need for shutdown at regular intervals to regenerate the resin.

Both process liquid and regenerant can be simultaneously and continuously introduced into a single column at different points. The two streams are kept separate by controlling their pressures.

Inside the column, the resin particles flow from top to bottom, being washed out through a pipe which returns them to the top. Process liquid, such as hard water, is piped into the side of the column, from which point it passes upward through the downcoming resin and comes out near the top of the column as soft water.

Farther down the column, near the bottom, regenerant comes in, takes up the waste from the resin while passing upwards, and leaves the column at a point near the middle, below that at which the hard water entered, without mixing with the water being softened.

### Mass Production Grows In Reinforced Plastics

Development of a low-cost process which introduces high-speed, mass-production techniques to the manufacture of fibrous glass-reinforced plastics products of nonuniform thickness has been announced by the Pressurform Co. of Swarthmore, Pa.

Fully automatic and continuous, process achieves precision

output of preforms which are the shape of the finished product but consist only of reinforcing material. Ribs, bosses and other protuberances become integral parts of the preform in one operation. Preforms can be turned out in 30 sec. to 2½ min., depending on design, a fraction of time used by conventional methods.

Reinforcement is made up of varying proportions of glass fibers and one of several organic materials. The preform, along with a resin, is placed in a mold under pressure to produce the finished product.

The Pressurform Co. was organized to license the process. Already licensed to use it is Banner Fiberglass Products Corp., Paterson, N. J., which will manufacture reusable airborne radar shipping and storage containers. Also licensed is Pressurform Container Corp., which has been manufacturing for developmental and demonstration purposes.

### Coal and Oil Companies Combine Forces

Sohio and Pittsburgh Consolidation Coal Co. have formed a jointly owned concern, Mountaineer Carbon Co., to operate a carbon calcining plant at Cresap, W. Va. And a Pittsburgh Consolidation subsidiary, Pitt-Consol Chemical Co., is about to start up a \$3.5-million Newark, N. J., plant to produce cresylic acids, cresols and phenols via a new continuous extraction process (*Chem. Eng.*, Dec. 1955, p. 138). Though developed by the parent company for coal-chemicals refining, the process at Newark will feed on petroleum refinery waste streams.

But a larger Pitt-Consol refinery, which will produce substantially the same range of chemicals from liquids derived from low-temperature carbonization of coal, is planned for operation at Cresap by late 1958. Combined output of the Newark and Cresap refineries will total about 60 million lb./yr. by 1960.

At the Mountaineer plant, part of the raw material will be petroleum coke supplied by Sohio, part will be coke supplied by Pittsburgh Consolidation Coal.



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**ISOPHTHALIC**  
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Users of ISOPHTHALIC are fast discovering this new Oronite chemical offers properties and cost advantages heretofore unobtainable. If you haven't inquired about or investigated Isophthalic in your own laboratory, it will pay you to do so. Technical data is available on many of its unique properties. Contact the Oronite office nearest you for complete information.

\*T.M.



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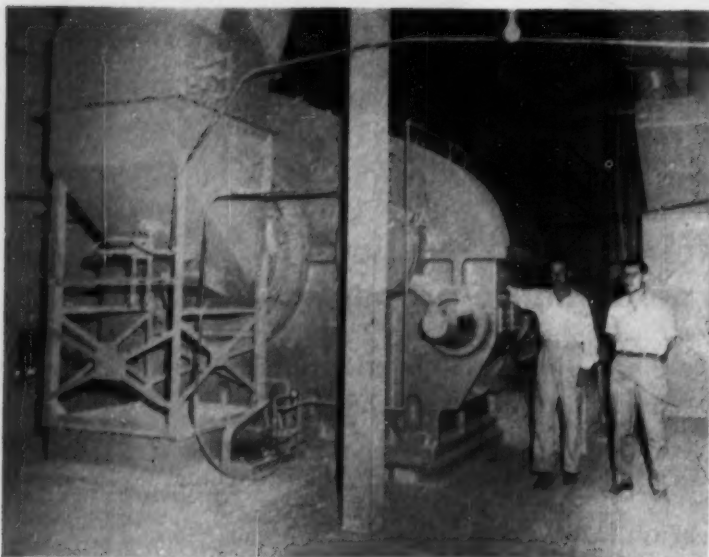
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ENGINEERS Reedy and Niemitz inspect AAC's ball mill at Pierce, Fla.

## Mills Grind Slow But Fine

**New shape of liner, reduced speed of rotation key successful application of ball mills to grinding of spongy Florida phosphate rock.**

With three installations already operating and additional ones under consideration, the ball mill bids fair to dislodge the roller mill's favored position among processors of Florida phosphate rock.

First to break with roller-mill tradition was Olin Mathieson Chemical Corp., who picked a 16.5-ton/hr. ball mill when expanding its Pasadena (Tex.) facilities in 1951. American Agricultural Chemical Co. followed two years later with a 44-ton/hr. unit at Pierce, Fla. Last year Armour Fertilizer Works, Bartow, Fla., put in a 35-ton/hr. ball mill.

► **Grinds by Attrition**—Credit for success of the ball mill in grinding spongy phosphate rock is due engineers G. Niemitz and R. W. Reedy of Kennedy-VanSaun Mfg. & Eng. Corp., Danville, Pa.

Niemitz and Reedy were looking for ways to overcome phos-

phate rock's ability to cushion the impact force on which ball mills primarily rely. They discovered that by fitting the Kennedy airswep ball mill—a machine that's built a solid reputation in the cement industry—with a new shape of liner and sharply reducing its rotation speed, they could change the nature of the balls' action and exploit the mill's attrition force which best grinds soft materials.

► **Burgeoning Trend**—While not yet replacing roller mills in existing facilities, the Kennedy ball mill, Reedy reports, has been named to practically every new grinding spot opened by the phosphate industry's vigorous expansion of the past five years. He feels that it's just a matter of time before a full-grown trend sets the ball mill up as the dominant machine for grinding phosphate rock.

What advantages has the ball

mill over the roller mill? According to Reedy, it's largely a matter of economics. "Wherever ball mills can do the same grinding job that roller mills do," he says, "they'll do it cheaper. Efficient ball-mill grinding offers hefty savings in maintenance, power, labor and, in larger capacities, in installation costs as well."

Though half the first cost of equal-size ball mills, roller mills are limited by present designs to top capacities of about 20–25 tons/hr. Ball mills, on the other hand, can be built in almost any size.

► **AAC Lends Support**—American Agricultural Chemical's unit shows what the size factor means to expansion planners. According to an AAC spokesman:

"To kick up our output at Pierce by about 40 tons/hr. we had the choice of installing two or three roller mills or one ball mill. First cost of a single, large ball mill was no more than the cost of three roller mills. So with roller mills' capital-cost advantage down the drain, we got real savings in building space, power and labor."

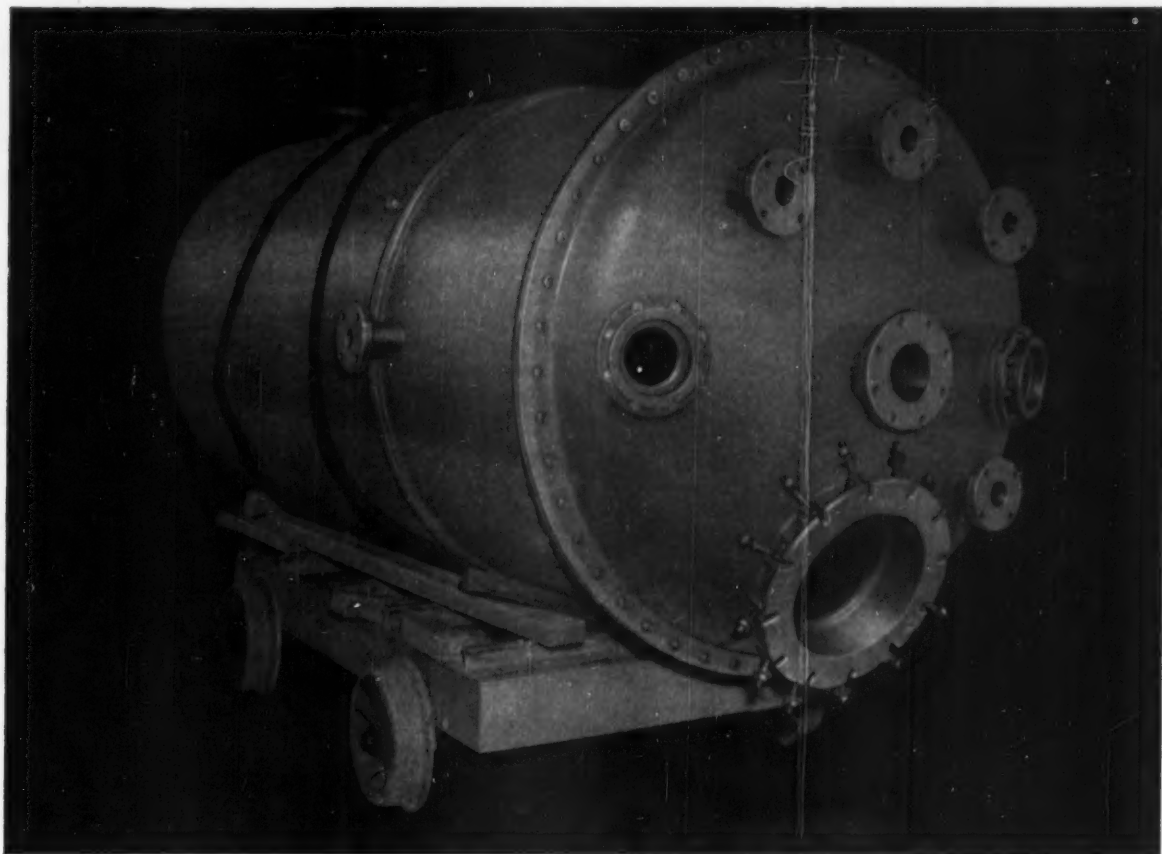
► **OM Got Balls Rolling**—When increasing markets for ground phosphate rock as a direct-application fertilizer spurred expansion of Olin Mathieson's facilities, OM engineers invited veteran ball-mill manufacturer Kennedy-VanSaun to try to develop a ball mill suitable for grinding phosphate rock.

Using Mathieson's plant for a proving ground and capitalizing on OM's intimacy with the peculiarities of phosphate rock, Reedy and Niemitz spent many an anxious hour at Pasadena, nursing along the pioneer installation. When they finally packed their bags and headed back to Danville, they had demonstrated a mill output 20% above the 15-ton/hr. guarantee.

► **How It Works**—The Kennedy airswep ball mill consists essentially of a horizontal cylindrical drum rotated slowly on its axis by a motor. A motor-driven fan circulates air through it.

Phosphate rock and steel balls feed into the mill together.





**Steel Steam-jacketed Still with bonded lead lining.** This unit, placed on side for transport through plant, is five feet I D by eleven feet deep. All

surfaces exposed to corrosion carry a  $\frac{3}{4}$ " lead lining bonded to the steel by National Lead's unique, improved process.

## National Lead weds lead to steel ...boosts life of lead-lined vessels

**L**ead-steel bonds in lead-lined equipment have never been as satisfactory as they are today ... thanks to the improved process by which National Lead *weds* lead to steel.

Mechanical abuse — impact, crushing, twisting — does not destroy the bond. "Torture tests," designed to pry the lead from the steel, do not separate the metals at the interface ... the union is stronger than the tensile strength of lead.

### Virtually indestructible

With the improved bonding method you get the kind of lining performance in massive vessels that you get from National Lead

"Tubond" pipe and "United" valves. Pressure, vacuum, vibration and heat (short of lead's melting point) don't disturb the lead-steel bond. Blistering, buckling and cracking are virtually eliminated even under severe and rapid cyclic temperature changes.

If your processing employs corrosives, National Lead fabricated vessels can bring you major savings in maintenance costs and cut losses due to production stoppages.

National Lead makes lead-lined equipment of all types and sizes, from small-bore "Tubond" pipe to tank cars and beyond. Write for quotations on any acid-handling equipment you have in prospect, furnishing, if possible, sketches or prints, and information on type of corrosive, flow factors, temperatures, pressures and other operating data. Address National Lead Company, Lead-Lined Dept., 111 Broadway, New York 6, N. Y.

## National Lead Process Vessels ...lined to last





Rotating motion of the drum carries the rock and balls up the lined interior wall, allows them to drop back through the air stream. While traveling up the wall the balls smear the rock against the liner, grinding by attrition. Falling back, the balls shatter more rock by impact. The ground fines are swept out of the mill by the air stream. The balls themselves are eventually pulverized and drawn out of the mill, too.

Periodically adding balls to the feed to replace those ground away maintains top grinding efficiency, insures continuity of production since shutdowns are unnecessary. This reduces maintenance to a minimum.

► **Cuts Down Impact Action—**

K-VS is keeping exact details of liner shape and rotation speed of its mill—keys to successful grinding of phosphate rock—under wraps. But Reedy explains that their combined effect is to hold the balls against the liner, controlling the balls' fall in the mill. Thus the mill relies on attrition grinding, not on the impact of the falling balls which the spongy rock easily cushions.

Other features of this specially tailored mill:

- **Liner material**—a heat-treated, semisteel called XX Herculite — shows excellent wear resistance.

- **Silencer jacket**—a 2-in.-thick hairfelt insulation—deadens operating roar, slices vibra-

tion to permit simple foundations and reduce personnel fatigue. It also retains the large quantities of heat generated in grinding to help dry the rock.

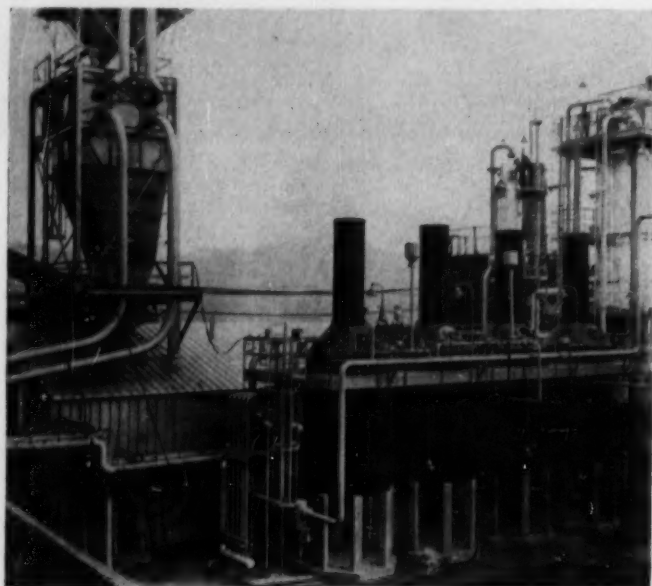
► **AAC's Versatile Plant** — Marketing ground rock for direct fertilizer use and also shipping to mixing plants for acidulation to superphosphates, AAC calls on its big ball mill to perform the widest range of grinding jobs. The  $-\frac{1}{2}$ -in. +100-mesh rock is pulverized to 50%, 65%, 70% or 85% through 200 mesh. Air velocity and classifier regulation permit the particle size to be controlled to  $\pm 1\%$  during operation.

The 44-ton/hr. mill, driven by a 600-hp. motor, is 10 ft. dia. by 15 ft. long. (K-VS reports it's ready to build bigger machines, up to 75 tons/hr.) Air-circulation fan is driven by a 200-hp. motor.

Rock feeds from a hopper to a disk feeder that measures its flow rate to the mill. At the end of every 8-hr. shift the operator going off duty dumps a bucket of 1½-in.-dia. steel balls—0.12 lb./ton of rock—into the hopper.

Fines drawn from the mill go to a radial-flow classifier which separates oversize particles and returns them to the mill. Correct-sized particles pass through two cyclone collectors, drop to a conveyor which loads them on trucks or railroad cars. The cleaned air is recirculated through the mill.

AAC reports that only one man is needed for the entire operation and that total maintenance cost is well under 2¢/ton of ground product.



### New Synthesis Gas Process Gets Plant Try

First commercial-scale unit using a new process for manufacture of ammonia synthesis gas by partial oxidation of coal went into experimental operation recently at the Morgantown, W. Va., plant of Olin Mathieson Chemical Corp. Coal-handling equipment, with gasi-

fier in the background, is above.

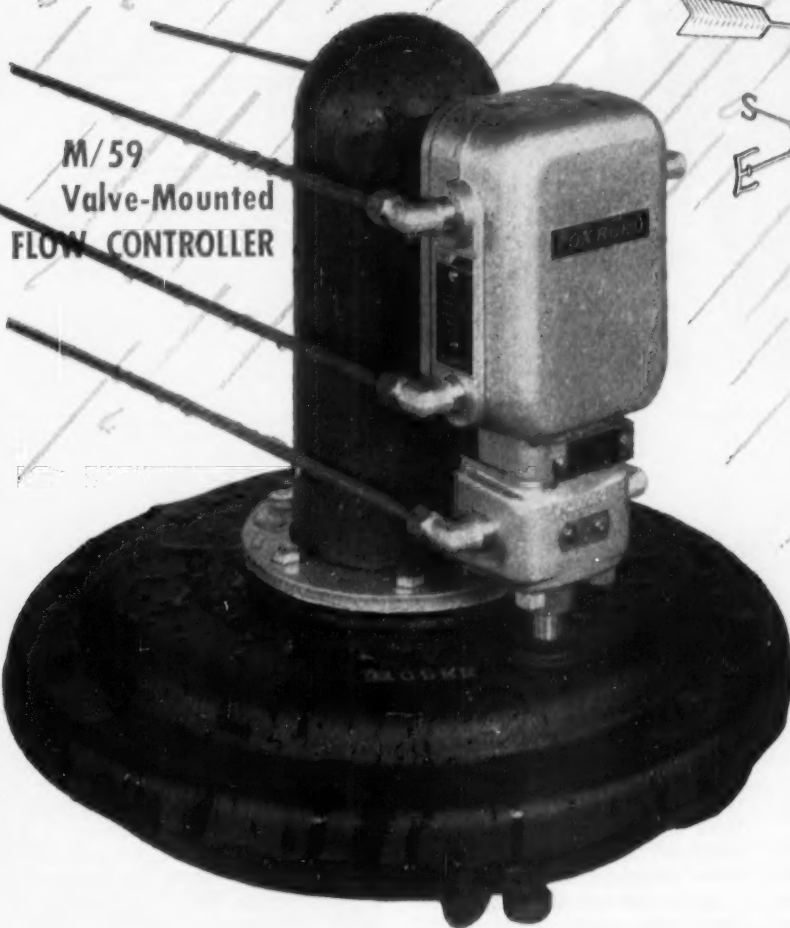
Process, developed by Texas Co., produces hydrogen and carbon monoxide. Enough is produced at Morgantown to make about 80 tons/day of ammonia or equivalent methanol. Units of the same size will eventually be used commercially.

### Industry Taking Hold In Atomic Development

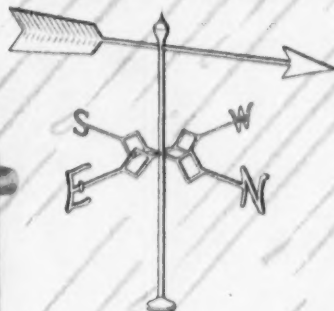
Martin Nuclear Div. has announced a highly improved fuel element, first to be successfully developed to this stage without the aid of a specific government contract. Tubular in shape, it will impart to some nuclear reactors the ability to increase their operating power by 50% and still maintain the same film-boiling safety factor.



# This Controller requires no more attention than a weathervane!



M/59  
Valve-Mounted  
FLOW CONTROLLER



Like a weathervane, the Foxboro M/59 Consotrol Controller can be installed completely exposed to the elements . . . and forgotten about! Unsurpassed in performance by any other flow controller, the M/59 is completely indifferent to weather conditions.

This rugged Flow Controller mounts directly on the air connection of the valve . . . at a fraction of usual installation cost. Its case is tightly gasketed, continuously purged, completely weatherproof, highly resistant to dust, fumes, and vibration. There's nothing to align, nothing to wear out. A flexure-strip fulcrum eliminates the friction and wear of conventional pivots . . . eliminates "conventional" maintenance.

In operation, the M/59 fully utilizes the speed and sensitivity of the Foxboro d/p Cell Flow Transmitter . . . does away with transmission lag . . . gives fastest recovery from process upsets. For the complete story, write today for Bulletin 470.

"Live-Balance" Control on any fluid with any size valve motor.

Lowest first cost. Lowest installed cost.

Lowest maintenance cost.

Unique Simplicity — exclusive design permits fixed, optimum proportioning and reset values for liquid flows. Adjustable reset optional for gas or steam flow.

THE FOXBORO COMPANY, 1012 NORFOLK STREET, FOXBORO, MASS., U.S.A.

## FOXBORO

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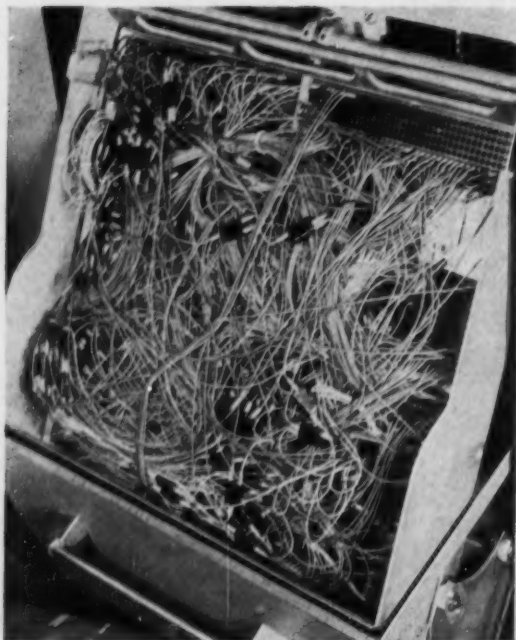
FLUID FLOW CONTROLLERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

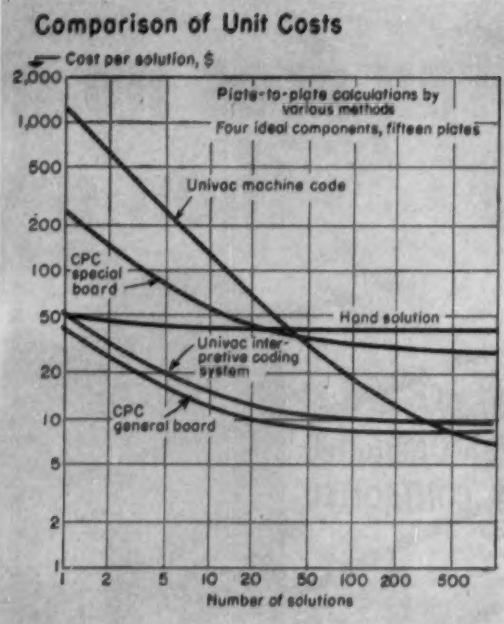
CHEMICAL ENGINEERING—December 1956

135





PLUG-BOARD wiring and testing, an expensive operation, controls the economics of machine computation.



## How You Can Save With Digital Computers

Du Pont study of computation costs points up the high cost of plug-board preparation, suggests general-purpose plug-board to reduce over-all costs.

Can expensive, high-speed digital computers actually save you money in solving chemical engineering problems?

Even rabid computer enthusiasts will admit that machine calculations can be more costly than hand calculations under some conditions. What are these conditions, and how can the break-even point be shifted by changing conditions?

A real start towards providing quantitative answers to such questions has been made by investigators in Du Pont's Engineering Research Laboratory, Wilmington, as recently reported by J. A. Beutler to the American Institute of Chemical Engineers in Pittsburgh in September.

► **Use General-Purpose Board**—Principal conclusion of the

Du Pont group is that use of general-purpose control boards is, in the long run, less costly than use of tailor-made boards designed specifically for each set of calculations.

Although actual computation time with a high-speed digital computer is small, the cost of the first solution to a series of problems is high because of the cost of plug-board preparation. Planning, wiring and checking out a control board for any desired computation method may cost 50-75% of the total cost of the computation.

► **Spread the Cost**—Many problems using the same control board are needed to spread preparation cost over a broad base. By using a general-purpose control board, says Beutler, you can write off this cost against a

large number of different problems.

Du Pont's preferred computer setup—at least as far as this particular study is concerned—is the IBM Model II Card Programmed Calculator with a general-purpose board. Beutler suggests a plug-board which performs "floating-decimal" arithmetic and can carry out an extensive repertory of operations beyond basic arithmetic, such as computing square roots, trigonometric functions and exponentials. Such a machine, although modest in size and cost compared with many other computers, is entirely adequate for most engineering design problems.

To particularize such a board for a specific problem, you must enter into the machine's memory unit the required physical property data and certain control information.

► **Economic Balance**—The general-purpose setup has several drawbacks:



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B. Van Leer N. V., Stadhouderskade 6, Amsterdam, Holland

Van Leer Industries, Ltd., Seymour House, 17 Waterloo Place, Pall Mall S.W. 1, London, England



### Time Required for Solving Typical Design Problem Using CPC With General Board

Preparation of flow chart.....	0.25-2 hr.
Preparation of code.....	0.5 -2 hr.
Key-punching of program cards.....	0.5 hr.
Program checking.....	0.25-1 hr.
Machine computation, per solution.....	0.17-2 hr.

• It requires a memory unit with considerable storage capacity, on the order of 10,000 "bits."

• The versatile plug-board arrangement is in itself not cheap; Beutler estimates that it takes 2,000 man-hr. and 100 machine-hr. to set it up.

• Coding of a specific program involves preparation of more program cards and lengthier computing procedures than with a board designed for the specific problem.

• Actual machine computation time, therefore, is longer.

Offsetting these negative points are the savings in man-hours and machine-hours which would otherwise be consumed in preparing special boards for each different type of problem. As shown by the graph (p. 136), Beutler's cost estimates favor general-purpose boards over special boards except where the number of problem solutions is well up in the hundreds.

► **Basic Problem**—Beutler's cost analysis was based on a problem in distillation column design involving 15 plate-to-plate computations with a four-component system. Choice of problem was not surprising in view of the fact that plate-to-plate distillation calculations were among the first chemical engineering problems to be put to digital computers.

The particular system involved four alcohols—methanol, ethanol, normal propanol and normal butanol—which were assumed to form an ideal mixture (i.e., one conforming to Raoult's law). The problem conditions, however, did not require constant relative volatilities.

► **Cost Data**—Using a rate of \$10/man-hr., Beutler estimates the cost of the first hand solution as \$50, decreasing to an asymptote of \$40 with additional solutions.

Cost of machine computation using the CPC is based on the same rate per man-hr. and a figure of \$25/machine-hr. For comparison, Beutler also estimated the costs of machine computation using a Univac with general and special setups. Univac time was figured at \$200/hr.

Included in the costs shown in the graph are these steps: Coding of program steps into computer terminology; preparation of punch cards; wiring of boards, where necessary; checking the program on the computer. Not included are preliminary engineering costs common to all computation methods, such as problem analyses, flow-charting and preparation of physical property data.

► **Self-Service**—Du Pont's philosophy relative to use of digital computers for solving engineering problems is to encourage the "do-it-yourself" idea. Beutler claims that a total of 8-12 hr. of instruction and operating experience with the Model II CPC, equipped with a general-purpose board, is sufficient training for solo use of the machine by the designer or researcher himself.

While some computer experts may disagree with this philosophy, Beutler will no doubt find widespread support of his conclusion that, for all but the simplest binary problems, machine solution of distillation column design calculations can now compete economically with hand methods.

### Japan Tries Sugar Route To Volume Silvichemicals

The Japanese government and private industry have been working on a plant to extract on an industrial basis glucose, molasses, acetic acid and other

materials from wood. A good bet for volume silvichemicals on grounds of raw material supply and markets, the saccharification of wood has thus far been beset with too many process difficulties for economic use in any country.

According to the Japanese plan, a plant to process 10 tons/day of lumber will be set up within a year. Capacity will be boosted to 40 tons if initial results prove encouraging.

### News Briefs

**Sulfur:** The first completely offshore sulfur mining operation will be undertaken by Freeport Sulphur Co. at a deposit discovered in the Gulf of Mexico by Humble Oil & Refining. Operations, to start late in 1958, will produce sulfur by the Frasch hot-water process.

**Pickle Liquor:** The nation's first pilot plant for disposing of steel plant waste acid by the Blaw-Knox Ruthner Process (*Chem. Eng.*, Feb. 1956, p. 132) has started up in Niles, Ohio. Project is sponsored by seven large steel companies.

**Uranium:** Homestake Mining Co. plans to build and operate a 570-ton/day mill in the Ambrosia Lake area of New Mexico to handle uranium ores.

**Antiknock:** Ethyl Corp. has started up a new plant for manufacturing gasoline antiknock compounds in Sarnia, Ont. The company has also announced plans for a new plant in the San Francisco Bay area.

**Fertilizer:** Production has started at the \$20-million Nitro-Chemicals Ltd. fertilizer plant in Medicine Hat, Alberta. Capacity—140,000 tons/yr.

**Acrylic polymers:** A \$2.5-million plant to make specialty acrylic polymers at Calvert City, Ky., will be completed by B. F. Goodrich in Oct. 1957.

**Paper:** St. Regis Paper Co. will build a 400-ton/day pulp and paper mill in Montana near the Kootenai River.



**CUT COSTS FROM BARREL TO BEARINGS...**

*Change lubrication methods from*

***Backward to Forward!***



# **ALEMITE "POWER HOUSE" BARREL PUMP**

***saves 95 man-hours for every 400-lb.  
drum of lubricant you use***

Lubricating hundreds of bearings by slow, outgrown hand methods is a costly waste of time and money. A modern Alemite "Power House" Barrel Pump does the job much faster—at less cost. You save 95 man-hours for every 400-lb. drum of lubricant used. And because a completely sealed Alemite Barrel Pump system gives cleaner, more efficient lubrication, you make big savings right down the line. Savings in less down-time, and lower maintenance costs . . . in greater efficiency and output.

Air-powered Alemite Barrel Pumps fit directly into either a 400- or 120-lb. drum, send lubricant wherever it is needed anywhere in the plant. Or drum and pump can be placed on a dolly to go right to the machines. You get the big advantage of a completely sealed system. Lubricant reaches bearings "refinery clean"—no mess or waste.

## **ALEMITE**

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**BARREL PUMPS**

Products of STEWART-WARNER CORPORATION



• An Alemite Barrel Pump, either air or electric powered, is inserted in a fresh drum of lubricant. Lubricant is still sealed—"refinery fresh."



• Now the Barrel Pump supplies lubricant, through pipe, anywhere in the plant. Operator simply carries a hose and control valve to outlet, hooks it in, applies lubricant.



• Where piping of lubricant is not practical, power lubrication can be brought right to the machine by simply mounting drum and pump on a dolly.



**FREE! New Booklet:**  
**"5 Plans for Better Lubrication"**

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Chicago 14, Illinois

Please send me my FREE copy of "5 Plans for Better Lubrication."

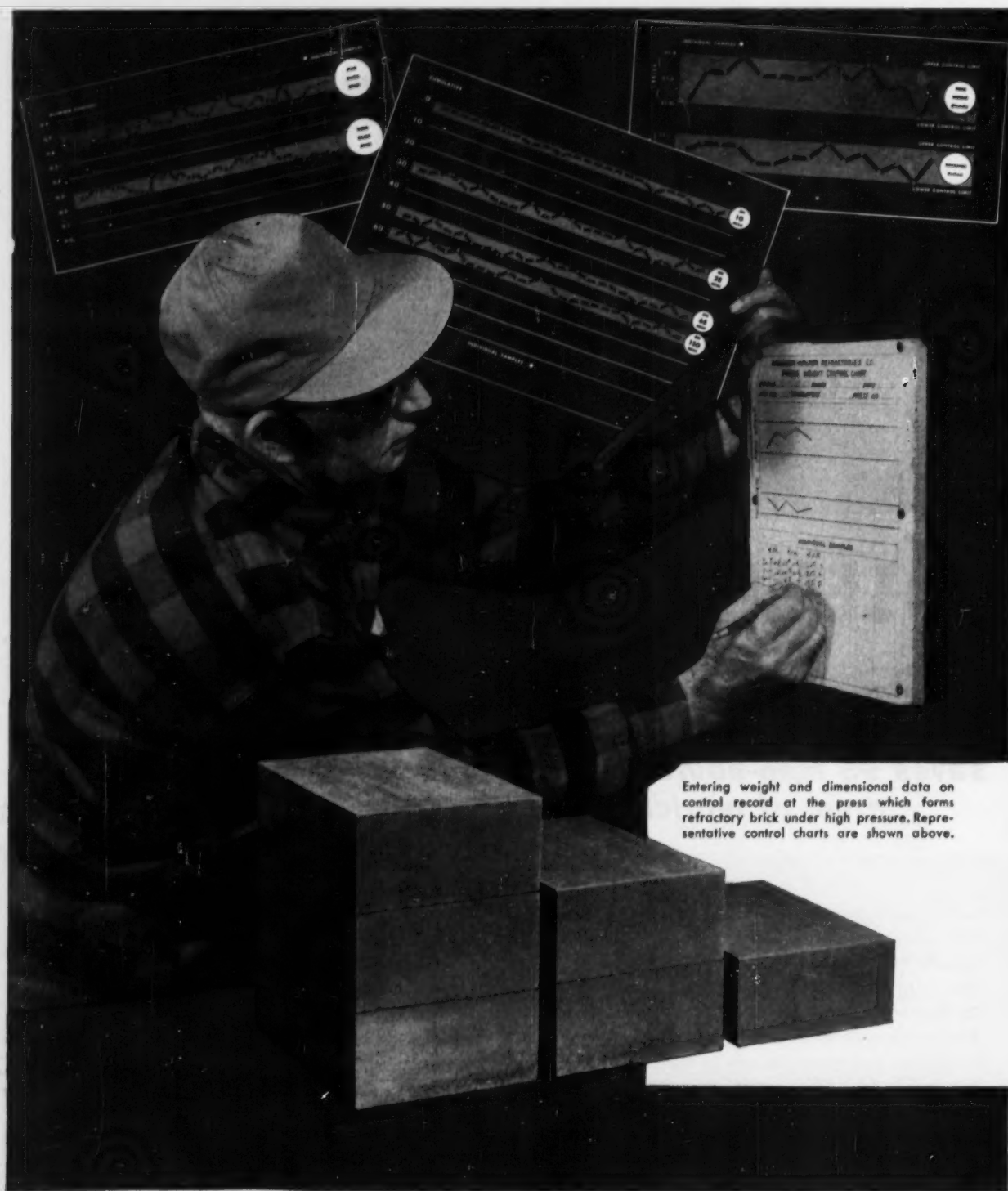
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Company

Address

City  Zone  State





Entering weight and dimensional data on control record at the press which forms refractory brick under high pressure. Representative control charts are shown above.



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Through Statistical Quality Control, Harbison-Walker maintains within closest commercial limits, the highest standards of all characteristics upon which depend the best and most uniform refractory service. Comprehensive control procedure extends from the raw materials through every manufacturing detail with the aid of instrumentation and precise laboratory testing. By this highly developed technique, uniformity of product is achieved which assures predictable and consistently uniform refractories performance. It is possible to estimate service life more accurately and plan furnace campaigns with confidence. With this established uniformity of quality, operating interruptions are fewer and maintenance costs are considerably reduced.

"Lump samples" of clay received from the mine are examined after test-firing.

Determining refractoriness by the "Pyrometric Cone Equivalent" method.

Screen analysis of Brick Mix is an important control operation.



## SEND FOR THIS BROCHURE

The program by which Harbison-Walker controls the properties and quality of the various refractories is described in detail in the new brochure *Better Refractories Through Quality Control*. It shows how uniformity is achieved and maintained in the refractories made from natural minerals from mines and quarries. A copy of this brochure will be gladly sent to you on request.



HARBISON-WALKER REFRACTORIES COMPANY  
Pittsburgh 22, Pennsylvania

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"Better Refractories Through Quality Control."

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BEFORE



AFTER

## Tough Plastic Seals Concrete Walls

**Epoxy-based polyplastic alloy waterproofs concrete permanently, withstands water pressure to 30 psi.**

Permagile, said to be the first material which can weld concrete, brick, cement and cinder block, all other masonry building products with a bond stronger than the joined material itself has been placed on the market nationally.

Described as an epoxy-based, industrial polyplastic alloy, the new bonding agent is extremely hard and tough, unaffected by aging or atmospheric conditions; unharmed by alkalis, most acids and chemicals.

Most extensive use at present is in the restoration of entire concrete buildings, tanks, grain elevators. Other applications: repair of major cracks and gaps in concrete sewers, floors, basements, exterior and interior walls. Also industrial waterproofing and repair "where all other materials have failed," surfacing of heavy-duty roadways, etc.

Here are some impressive figures claimed by the manufacturer for its new product:

- Tensile strength—8,000-10,000 psi.
- Compressive strength—35,000 psi.
- Temperature stability—-20 to 270 F., including repeated freezings and thawings.

- Elasticity—30-40 times that of normal concrete.

- Water absorption—0.12-0.13%.

- Resistance to water pressure—to 30 psi.

Permagile will be available in special formulations for its specific functions—joining, filling, cladding and surfacing. And the selling price, about \$3/lb., will vary somewhat with formulation and quantity.—Permagile Corp. of America, 37-23 33rd St., Long Island City 1, N. Y. 142A

## Drilling Muds

**Open up oil reservoirs too deep to be reached by ordinary drilling methods.**

A new class of oil-well drilling fluids containing nonionic surfactants is now being made available to the oil industry by Socony Mobil.

Compared with conventional drilling muds, the new fluids:

- Permit close control of flow properties where conventional mud systems fail.
- Permit faster penetration rates and savings in rig time through reduction in hole damage and stuck pipe.

- Resist solidification at temperatures above 300 F. in wells deeper than 15,000 ft., thus removing a serious limitation on the finding of deeper oil horizons.

One such fluid, a calcium surfactant mud, was successfully used last spring in the completion of a 22,570-ft. wildcat well in South Louisiana. And earlier, this fluid enabled Magnolia Petroleum to continue drilling a deep Texas wildcat even after encountering a bottom-hole temperature above 400 F.

Under a licensing agreement with Socony Mobil, General Aniline & Film will manufacture the essential ingredients of the new fluids. And the products will be sold by its Antara Chemicals Div., under the trademarks DMS and DME, through regular mud-supply companies.—Socony Mobil Oil Co., Inc., 150 E. 42nd St., New York, N. Y. 142B

## Ceramic Magnet

**Can be permanently magnetized to hold its strength under adverse conditions.**

According to North American Philips Co., there's a bright future ahead for a new ceramic material, Ferroxdure.

For not only can this non-metallic, electrically nonconductive material be permanently magnetized to hold its strength under the most adverse conditions, but it also:

- Eliminates reliance on critical and costly metals—e.g., cobalt, nickel—which, in times of emergency, are often unobtainable.

- Remains unaffected by external fields.

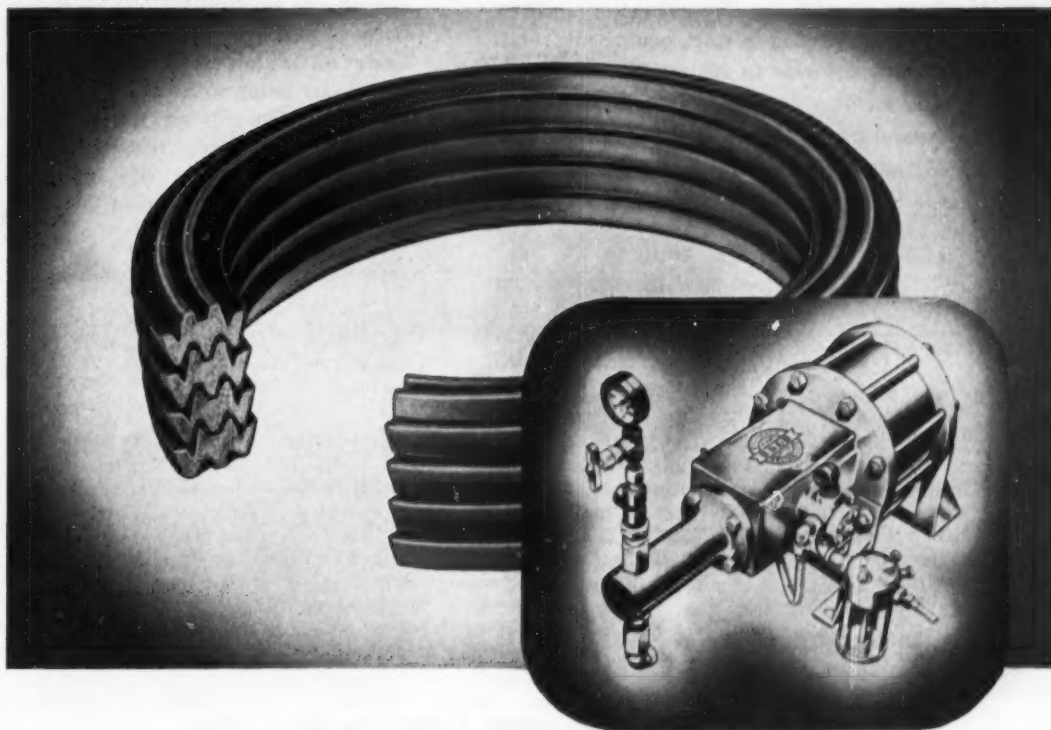
- Is practically impossible to demagnetize once it's been polarized.

- Can be molded into various shapes.

Compared with metal magnets, Ferroxdure magnets are smaller in size, lighter in weight, have longer effective life, provide improved performance and cost savings.

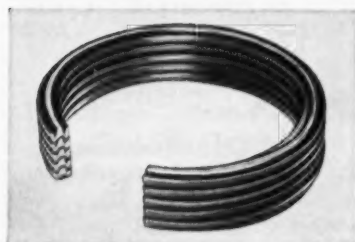


# J-M Uneepac<sup>®</sup> does it again!



"Very satisfactory sealing service  
against wide variety of fluids  
and pressures up to 5,500 psi"

says Black, Sivalls and Bryson, Inc.  
makers of BS&B Glycol Pump



Uneepac comes in two types. Shown here is design for flange widths up to  $\frac{1}{2}$ " which is used in BS&B Glycol Pump. Large illustration above shows design for flange widths over  $\frac{1}{2}$ ".

Chalk up another success story for Uneepac—Johns-Manville's automatic ring packing. In the BS&B Glycol Pump, fluids handled include triethylene glycol, diethylene glycol, gasoline, and various types of oils, alcohols and petroleum treating chemicals. Working pressures range from 125 psi to 5,500 psi with average operating pressures at 3,000 psi. Yet despite these rugged service conditions, Uneepac has delivered—in Black, Sivalls and Bryson's own words—"very satisfactory service."

Many other packing users have acclaimed J-M Uneepac for its long, trouble-

free service. Each ring is a complete packing unit. Fewer rings are needed than ordinarily required and stuffing box size can be reduced to the minimum. Each ring centers itself automatically on the preceding ring to simplify installation. This exclusive design also permits fluid pressure to act upon each lip individually and protects lips from excessive gland pressure.

J-M Uneepac comes in a wide range of styles and sizes for many rod and plunger applications. For further information write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

**Johns-Manville PACKINGS, GASKETS and TEXTILES**





Tough plastic seals concrete walls.....142A  
 Drilling muds open deep oil reservoirs...142B  
 Ceramic magnet vies with metal magnets...142C  
 Insulating varnish for Class B motors...144A  
 New Teflon extruded in stock equipment...144B  
 Paint latex superior to competition.....144C  
 Silicone yields void-free insulation.....146A  
 Transparent tape beats cellophane tape...146B  
 Speedy auto finish features high gloss...146C  
 Textile treatment repels oily stains.....148A

Welded graphite for nuclear reactors....148B  
 Liquid neoprene protects wood, metal....148C  
 Gear-oil additives lower in price.....150A  
 Polyglycols as chemical intermediates....150B  
 Defoamers aid in papermaking.....150C  
 Castor oil has low metal content.....150D  
 Aluminum paint withstands 1,700F.....150E  
 Expanded foam poly offered for first time...150F  
 Fluorocarbon sealants resist chemicals...150G  
 Diisocyanate price cut 50%.....150H  
 Silicone defoamer disperses instantly....150I

↑ Page number is also Reader Service code number ↓

For more about any item, use Reader Service Card

A number of American firms are already licensed to manufacture the new magnetic ceramic. — North American Phillips Co., Inc., 100 E. 42nd St., New York, N. Y. 142C

### Insulating Varnish

**Polyester-base, eliminates need for silicone varnishes in Class B motors.**

A "first" in motor making, according to Schenectady Varnish Co., is the introduction of a new polyester-base insulating varnish which permits manufacture of Class B electric motors without the use of expensive silicone varnishes and enamels.

The new varnish, called Isonel, was developed to meet the electrical industry's demand for an insulating varnish with:

- Heat resistance similar to class B wire enamels (e.g., Schenectady's Isonel, General Electric's Alkanex).

- Handling and curing characteristics adapted to the manufacturing cycles and curing temperatures currently used by electrical manufacturers.

Class B equipment can withstand short-term operation at 135-140 C. Conventional motors must work under the Class A limit of 105 C. hot-spot temperatures. Advantage of the higher temperatures is greater motor efficiency—25-30% more power per pound. Thus a Class B motor 25-30% smaller can

handle jobs of an equal-power Class A motor.

The new varnish is completely heat reactive, curing to a tough, solid mass at 180 C. It can be readily thinned with mineral spirits.

Isonel's cost is \$3.50/gal., while that of top-quality material for Class A work is \$2/gal. (Silicone motor varnishes average about \$15/gal.) — Schenectady Varnish Co., Inc., Schenectady, N. Y. 144A

### Teflon Resin

**Has melt viscosity low enough to permit extrusion in standard equipment.**

Teflon 100-X perfluorocarbon, an experimental product in Du Pont's line of Teflon tetrafluoroethylene resins, approaches conventional Teflon's heat and chemical resistance but has a low enough melt viscosity to permit extrusion in standard equipment. (Conventional Teflon, because of a high melt viscosity, requires special equipment and techniques for extrusion.)

While the properties of 100-X are similar to conventional Teflon resins, there are, however, some differences affecting its end use. Present Teflons are serviceable at higher temperatures and have greater flex life than the new experimental product. Therefore 100-X isn't expected to supplant Teflon 1, 5, 6 and 30 which are currently available in commercial quantities.

Primarily, 100-X is expected to make the essential properties of Teflon resin available over a broad range of new applications previously not attempted because of processing difficulties. For example, laboratory tests show that the new product permits extrusion of tubing, rod, wire coating and sheeting in conventional equipment.—Polychemicals Dept., E. I. du Pont de Nemours & Co., Wilmington 98, Del. 144B

### Paint Latex

**Fortified styrene-butadiene copolymer claims enhanced properties.**

Dylex latex K-34 owes its increased pigment binding strength, improved adhesion, superior mechanical and chemical stability to its chemical composition and fine particle size.

Paints prepared with the new fortified styrene-butadiene copolymer:

- Can be formulated with

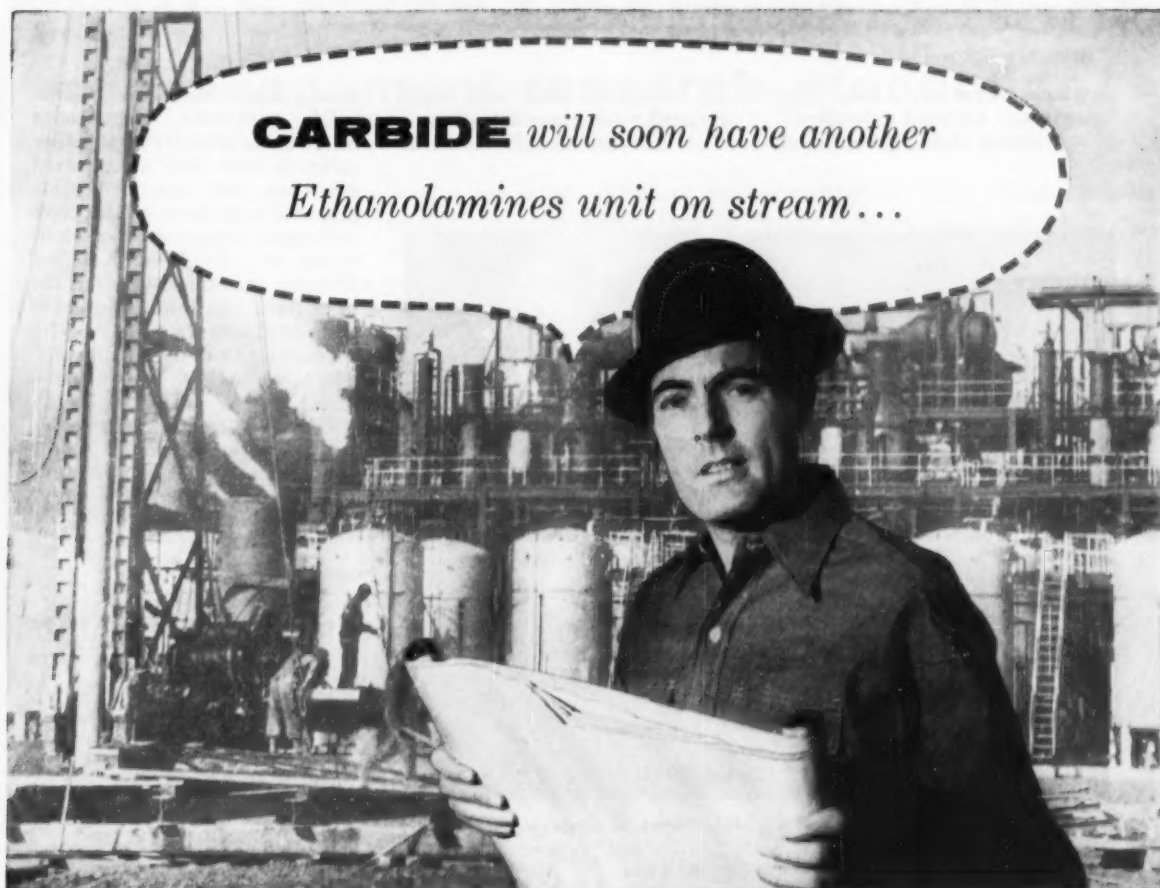
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about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.





**CARBIDE** *will soon have another  
Ethanolamines unit on stream...*

*here's how you'll benefit...*

CARBIDE's Seadrift, Texas plant will soon be pouring out ethanolamines to meet growing needs for acid gas absorbents and vital components of soluble oils, detergents, and soaps. This means that there will be two plants—South Charleston, West Virginia and Seadrift—supplying you with ethanolamines.

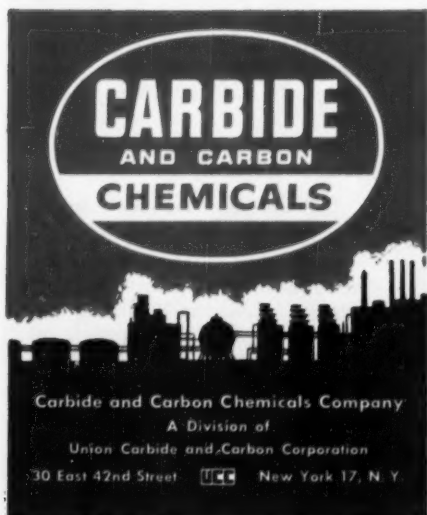
You can share in this increased availability by checking with your CARBIDE Technical Representative now.

Here are at least three ways you can benefit by choosing CARBIDE's ethanolamines today:

- You receive immediate delivery of mono-, di-, or triethanolamine—in the size shipment you need from the CARBIDE warehouse in your area.
- You profit through complete technical help from the world's first—and leading—producer of ethanolamines.
- You don't have to worry about continuous supply—especially with CARBIDE's plants drawing on a constant source of raw materials.

Write today for your copy of the booklet "Nitrogen Compounds," which discusses applications, physical properties, and specifications for CARBIDE's ethanolamines. Address—Carbide and Carbon Chemicals Company, Room 308, Dept. H, 30 East 42nd Street, New York 17, New York.

*In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal.*





## CHEMICALS . . .

typical water-dispersible pigments and low-cost extenders.

- Retain their pigment bind-

ing strengths even with high pigment volume concentration.

- Are easy to apply and clean,



SOLVENTLESS RESIN beats lead, other resins in temperature test.

## New Silicone Yields Void-Free Insulation

**High-temperature, high-voltage material provides greater heat resistance than other insulating resins.**

Silicone sans solvent. That's the key to success for Westinghouse-Dow Corning's jointly developed high-temperature, high-voltage electrical insulation.

- **High voltage**—By eliminating the solvent formerly necessary in other heat-resistant resins (to make them fluid enough for application), it's now possible to produce an insulation entirely free of air spaces or bubbles—traditional weak spots which break down at high voltage, causing insulation deterioration.

- **High temperature**—An indication of the new insulation's heat-resistant properties can be seen in the above hot-plate demonstration. While lead melts and conventional insulating resin (right) smolders, solventless silicone (left) remains in tact. Actually, the new resin can op-

erate continuously at 250 C. for thousands of hours.

Many applications are foreseen for the new material, e.g., impregnation of electronic components used in aircraft and missiles, high-voltage transformers, generator and motor insulations of greater thermal endurance and greater reliability.

The most important advantage in its use lies in the size and weight reduction of equipment—particularly vital in the aircraft field. Because the resin can tolerate higher temperatures, smaller parts (which normally generate excessive heats) can be substituted in electrical components. The result: smaller, lighter and less expensive equipment. —Westinghouse Electric Corp., Pittsburgh, Pa.; Dow Corning Corp., Midland, Mich.

146A

have a high scrubbability level.

Of particular significance where large inventories of either paints or latex itself are involved are these test results: Paints prepared with the new latex have undergone numerous freeze-thaw cycles at -50 F. with minor changes in viscosity. And the latex itself has been subjected to over 40 freeze-thaw cycles with no apparent change in viscosity. Storage stability, too, is excellent.

Dylex latex K-34 is available as an emulsion in 55-gal., non-returnable drums or in tank car or tank truck lots.—Koppers Co., Inc., Pittsburgh 19, Pa.

144C

## Pressure-Sensitive Tape

Uses polyethylene-surfaced cellulose backing.

Tentatively designated as tape No. 66, a new transparent, pressure-sensitive tape has been introduced which is claimed to have a number of advantages over plain cellophane tape.

The new product uses a special polyethylene-surfaced cellulose backing. Its adhesive is a special long-aging, pressure-sensitive transparent resin. Its top surface resists acids and alkalis; is impermeable to greases, oils, powders.

Unlike regular cellophane tape, No. 66 has dimensional stability with flexibility at low temperatures, isn't brittle, won't dry out, has a long life.

Present plans are to limit its availability to business and industrial users.—General Tape Corp., First National Bank Bldg., St. Paul 1, Minn. 146B

## Auto Finish

Combines lacquer speed with enamel gloss.

Following on the heels of an announcement from Martin-Senour (Sherwin-Williams affiliate) on the introduction of Dythol fast-drying auto finish (*Chem. Eng.*, November, 1956, p. 144) comes word from Sherwin-Williams that it, too, has a new speed enamel on the market called Exlon.

Aside from its rapid drying



# NEW Solvay Chemicals Book for management-research-production!

Here is the latest edition of SOLVAY's Products Book, which contains up-to-the-minute information on SOLVAY's entire line of chemicals and chemical products. This book includes a description of the individual products, their varied forms, basic physical and chemical properties and packaging, along with a listing of fundamental uses.

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speed, claims touted for the new paint include:

- Fast application—two coats in 20 minutes.
- Air drying—needs no baking.
- No odor, sticky overspray or spray dust.

As important as speed of application and drying is Exlon's outstanding wrinkle-proof qual-

ity. "Even when literally poured on a car, the enamel levels off to a smooth, mar-free finish." And this, without use of anti-wrinkling additives. Another feature: Noticeably high gloss which is retained practically throughout the long life of the finish.

Keeping pace with color trends, Exlon has been intro-

duced in colors matching those of 1957 cars.—**Sherwin-Williams Co., Cleveland 1, Ohio.**  
146C

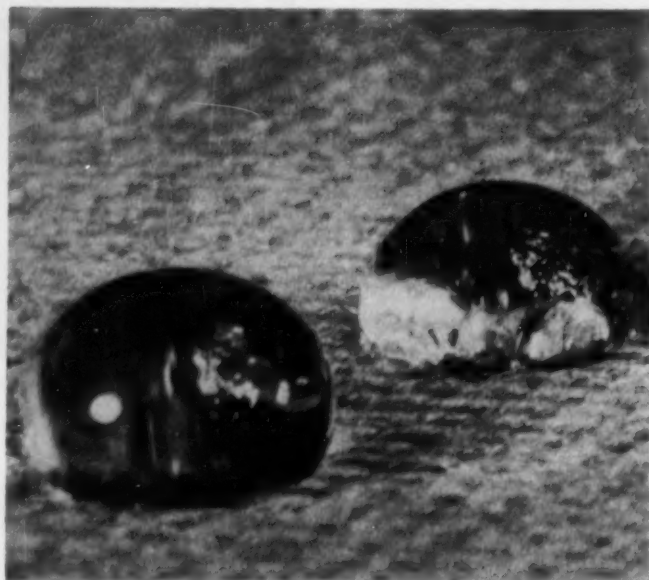
### Welded Graphite

**Opens new possibilities in nuclear reactor construction.**

At the fall dedication of Union Carbide's new research facilities (Parma, Ohio) came word that National Carbon scientists have succeeded in welding pieces of graphite together.

Basically, the new technique involves a melting operation. Pieces of graphite to be joined together are placed in an atmosphere of argon under high pressure, brought into contact and a direct current passed through them. Next, the pieces are separated slightly, creating an arc that heats the graphite to extremely high temperatures. This combination of heat and pressure melts the graphite and the pieces are welded together. (Under normal pressures, graphite doesn't melt when heated to high temperatures. Instead it vaporizes directly into a gas.)

The most immediate significance of the new process lies in the possibility of prefabricating sheets and panels of graphite for the assembly of nuclear reactor moderators which now must be built up from graphite blocks.—**National Carbon Co., 30 E. 42nd St., New York 17, N. Y.**  
148B



### Textile Treatment Repels Oil-Borne Stains

All too often, the most meticulous of persons succumbs to carelessness—carelessness that results in oil-stained clothing.

But now, for the first time in the history of the textile industry, a new fabric treatment—with fluorochemicals—has been introduced which, in effect, protects you against yourself. Called Scotchgard, this treatment makes fabrics resistant to pesky oil-borne stains (e.g., lube oils, cooking greases, gravies). And it will also resist water-borne and combination stains.

Basically, Scotchgard's effect is to make fibers of treated fabric resist wicking, i.e., soaking up liquids. Oil, water and fluorochemicals won't mix. Hence,

staining fluids stand on the surface of the fabric (*see above*) and don't penetrate. And should slight soiling occur, the stain is easily removed with ordinary solvent spot-remover—without leaving a ring.

Fluorochemical application takes place during the fabric-finishing process. The result: A fabric which can be commercially cleaned at least five times and still retain oil repellency.

First fabrics with Scotchgard will be in men's apparel and upholstery materials. These will be available to the public soon after the first of the year.—**Minnesota Mining and Mfg. Co., 900 Fauquier St., St. Paul, Minn.**  
148A

### Liquid Neoprene

**Protects wood, metal, glass, masonry, fabric.**

Liquid neoprene, which is applied as easily as paint and provides a protective rubber coating, has been developed for use around the home.

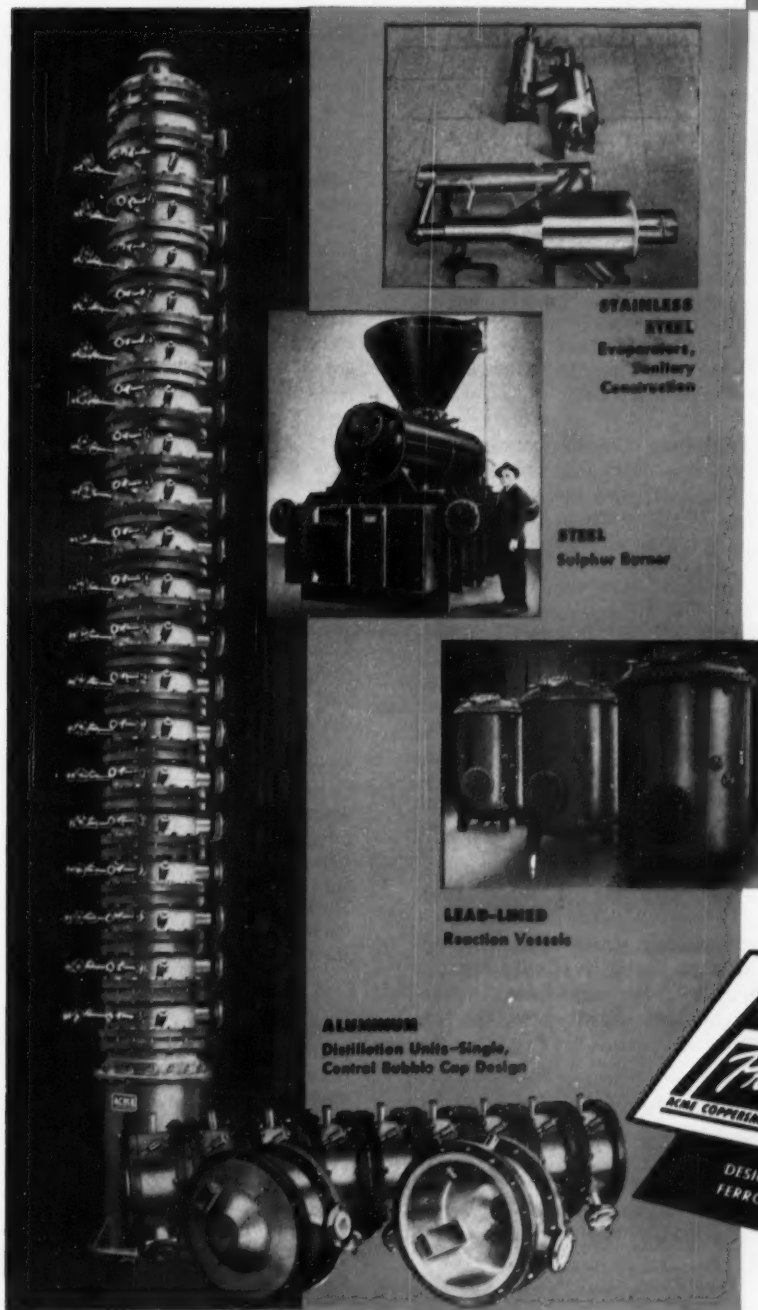
Called NeoGuard, the liquid synthetic bonds firmly to almost any clean surface and hardens into a tough, abrasion-resistant rubber film. It's not harmed by changes in climate or exposure to sunlight, nor damaged by oils and greases.

Application is easy with



# VERSATILITY

- \* DESIGN
- \* ENGINEERING
- \* FABRICATION



STAINLESS  
STEEL  
Evaporators,  
Sanitary  
Construction

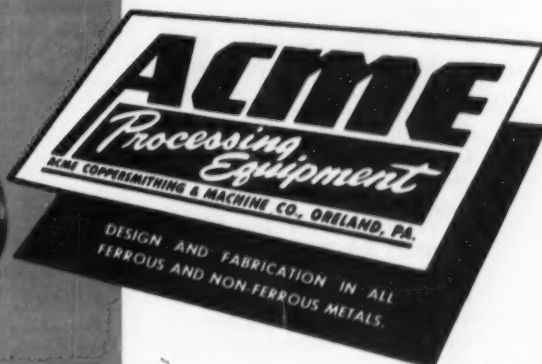
STEEL  
Sulphur Burner

LEAD-LINED  
Reaction Vessels

ALUMINUM  
Distillation Units—Single,  
Control Bubble Cap Design

**I**n the process industries, versatility applies to more than one phase of equipment production. At Acme, versatility includes working with all the ferrous and non-ferrous metals . . . with all types of equipment . . . and with virtually all processes.

For many applications, Acme has developed specialized types of equipment that offer unusual advantages in production efficiency and in operating economy, such as the Patented Sulphur Burner illustrated here. But whether a unit of specialized or of standard design is required, Acme versatility assures the maximum in performance.





brush, roller or spray. And a single coat is said to give a protective film equal in thickness to 6-10 coats of ordinary paint.

Uses for NeoGuard are many and varied. It can waterproof roofs, porches, sun decks, tarpaulins; will serve as a rust protector for gutters, drain pipes, etc. It should also prove useful in skidproofing surfaces such as house steps and walks.

The new product comes in black, gray, orange, red and aluminum. Price: \$11.25/gal. in 5-gal. pails.—**Marine Guard Corp.**, Edgemont, Pa. 148C

#### BRIEFS

**Price cut of gear-oil additives.** Santopoid 22 and Santopoid 22-RI, marks full-scale production of these new compounds. Bulk price, formerly 36¢/lb., is now 28¢/lb. Both additives meet present MIL-L-2105 specs and reportedly enable multipurpose gear oils to meet or exceed L-37 High Torque tests and Buick 10-A test of high speed and shock.—**Monsanto Chemical Co.**, 1700 S. Second St., St. Louis 4, Mo. 150A

**Three series of new polyglycols**—polyepichlorohydrin, polystyrene glycol and polybutylene glycol—hold promise as intermediates in the production of polyurethanes, surfactants, paints, detergents, plastics, coatings, etc. Polyepichlorohydrin, designated Polyglycol 166, is available in molecular weights of 450, 900 and 1,150. Polystyrene glycol, Polyglycol 174, may be had in molecular weights of 500 and 750. Polybutylene glycol series includes four molecular weights—B-500, B-1000, B-1500 and B-2000. All three series are being offered in sample quantities.—**Dow Chemical Co.**, Midland, Mich. 150B

**Two defoamers for the paper industry** are Witco Defoamer 2A and Defoamer 3—liquid, nonionic surfactants. By preventing foam formation in white water returning to the

feed box of paper-making machines, both compounds help produce a finished paper free from objectionable air voids. Defoamer 2A is also effective in scrap paper deinking processes. Defoamer 3 is particularly good as a leveling agent for starch and proteinaceous adhesive-type coating colors.—**Witco Chemical Co.**, 122 E. 42nd St., New York 17, N. Y. 150C

**Low metal content hydrogenated castor oil**, with less than 10 ppm. of heavy metal, is available in flaked form under the tradename Primawax. Because of its low heavy metal content, it should prove of value as a plasticizer in cellulose nitrate, vinyl, rubber; in lube greases and oils and generally where heavy metals catalyze oxidation and deterioration.—**U. S. Cotton Oil Co., Inc.**, 194 Henderson St., Jersey City, N. J. 150D

**High-heat aluminum paint**, C-I Extra High, is capable of withstanding temperatures to 1,700 F. without blistering or burning. Composed of a silicone base with special aluminum flake pigment, it air-dries to a bright finish in about 30 minutes. When heated, it virtually fuses with the surface on which it's applied. Extra High forms a coating that resists moisture, corrosion, mild acids, alkalis, industrial fumes. Recommended for: condensers, heat lines, ovens, compressors, etc.—**Chem Industrial Co.**, 3784 Ridge Rd., Brooklyn 9, Ohio. 150E

**Expanded foam polyethylene**, said to be available for the first time anywhere, is unicellular, light in weight, ex-

tremely buoyant, has a tensile strength of 500-600 psi., has excellent compressibility. Offered in such semifinished molded components as rings, blocks, rods, sheet, the new material, Agilene-F, may be used for heat and electrical insulation, sound proofing applications, etc.—**American Agile Corp.**, P. O. Box 168, Bedford, Ohio. 150F

**Fluorocarbon sealants**, known as Flurans, are completely stable, plasticized fluorocarbon resins plus chemically inert fillers. They're resistant to fuming nitric and other highly oxidizing acids, salts, etc. and they're nonvolatile, nonflammable, nontoxic, contain no solvents. Temperature resistance of fused Fluran is 225-275 F. Uses include filleting, caulking or gasketing material in all types of slip joints, flanges, rigid PVC, glass, etc. Three sealants currently available are Fluran J-10 (hard, rubbery), Fluran J-20 (moderately soft) and Fluran J-30 (soft). Price: \$55/lb.—**Chemical Process Equipment Div.**, U. S. Stoneware Co., Akron 9, Ohio. 150G

**50% price reduction on MDI diisocyanate**, Nacconate 300, should be good news to potential urethane producers as well as to adhesives and rubber manufacturers. Compound, formerly priced at \$3.50/lb., is now \$1.75/lb. And similar price cut—down to \$1/lb.—applies to Nacconate 300 when furnished as a 50% solution in *o*-dichlorobenzene.—**National Aniline Div.**, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y. 150H

**Fast-acting silicone defoamer**, Antifoam B, is instantly dispersible in aqueous systems, may be added "as is" without stirring or agitation, stays in suspension longer, is resistant to both heat and cold. It's ideal for continuous processing; won't oil out, plate out, settle or precipitate in most applications.—**Dow Corning Corp.**, Midland, Mich. 150I

#### For More Information...



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.



# This advanced-type equipment is making MORE PROFITS FOR PROCESSING INDUSTRIES

The principles of attrition-grinding and impeller-dispersing as embodied in the new models of Morehouse Mills and Cowles Dissolvers are producing

spectacular results in over 70 industries throughout the world. They can do the same for you.

**LET US PROVE IT IN YOUR PLANT — AT OUR RISK!**

## TYPICAL MOREHOUSE MILLS

Many models to choose from — capacities from 1 to 2000 gals. pr. hr.



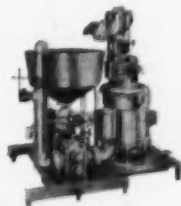
MODEL B-2000. Height, 66 $\frac{1}{8}$ " ; width, 31 $\frac{1}{8}$ ".



MODEL M. Height, 38 $\frac{1}{8}$ " ; diameter, 14".



MODEL SS-30. Height, 50" ; diameter, 20".



MODEL B-2005 Grease Mill and Deaerator. Height, 72" ; width, 28".

If you process products like these —

ADHESIVES	FILTER CAKE
FUNGICIDE	COATINGS
PAINTS	ENAMELS
SODIUM DISPERSIONS	SOLIDS CONCENTRATIONS
STARCH COOKING	GAS DISPERSIONS
PLASTISOLS & ORGANISOLS	PLASTER DISPERSIONS
POLYESTER RESINS	INKS

... there is a Morehouse or Cowles unit to meet your needs — in stainless steel where required.

Morehouse attrition-grinding mills reduce particle size by processing the material between a stator and a rotor that operates at ultra-high speed — up to 5400 R.P.M. As a result amazing volume is produced in a fraction of the space required by ordinary equipment. Micro-adjustment assures accurate control and duplication of desired particle size with consequent improvement in appearance, texture and overall quality. Operation is smooth, practically vibrationless, and trouble-free.

Cowles impeller-dispersing dissolvers easily handle viscosities in excess of 50,000 centipoises. Patented impellers rotate at peripheral speeds of 2000 to more than 5000 F.P.M., producing great shear, impact and turbulence. Volume is increased many-fold over old style mixers. Ultimate dispersion is achieved in a fraction of the time. Quality improvement is immediately apparent.

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Make more profits with Morehouse and Cowles.**

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**MOREHOUSE-COWLES, INC., 1150 San Fernando Rd., Los Angeles 65, Calif. Representatives in Principal Cities (Cable Address "MORESPED," Los Angeles).**

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Many models to choose from



10 AND 20V with hydraulic lift. For big-volume production. 80" high, 10-40 HP.



10 AND 20D, for installation on your own tanks. For adaptation up to 40 HP.



7-VTV. Mobile Tip-Up Type. For 5 to 80 gallon batches. Max. tilt will accommodate 46" tank.

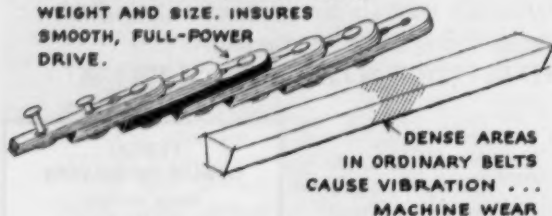


1-VG Laboratory Lift-Up Type. For testing, pilot plants and small batches. Results identical to production-size models. Max. rise, 10".



# Six Reasons Why Veelos Adjustable V-Belts Are Better For Your Drives!

EACH VEELOS LINK IS IDENTICAL IN WEIGHT AND SIZE. INSURES SMOOTH, FULL-POWER DRIVE.

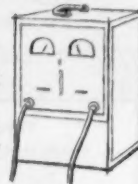


**1. Balanced construction** of Veelos Belts assures you faster, cleaner work, less rejects... less bearing wear. Each link and stud is identical in size and weight. Ordinary belts have varying spots of density which cause excess vibration—chatter marks, machine wear.

STROBE LIGHT PIN-POINTS CAUSE OF COSTLY VIBRATION.

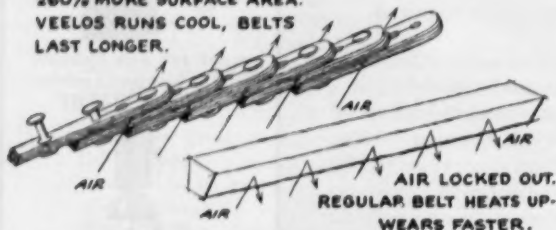


MEASURES VIBRATION DOWN TO 2 MILLIONTHS OF AN INCH. COMPARES THE DIFFERENCE, YOUR ENDLESS BELTS-AGAINST VEELOS.

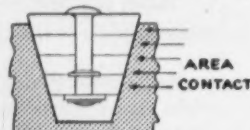


**2. Electronic proof**—up to 90% less vibration! With a vibration analyzer, you see, on your own machine, how Veelos belts decrease vibration up to 90% over any belt you're now using. This amazing Veelos test pin-points the belt that has the "invisible shakes."

260% MORE SURFACE AREA. VEELOS RUNS COOL, BELTS LAST LONGER.



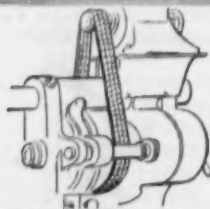
**3. Cooler running—long life!** Veelos breathes! Constant circulation of air keeps Veelos running smooth. Regular V-belts have no chance to cool, heat builds up from the inside... causes slippage, wastes power, heats bearings, reduces belt life.



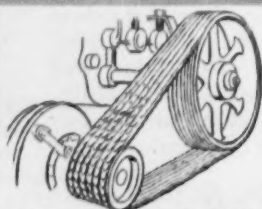
**4. Greater flexibility** reduces slippage! Sectional construction, beveled links allow greater flexibility, longer belt life. Each link moves around sheave independently and maintains full contact, constantly. Full area contact allows shorter centers, smaller sheaves.



**5. Simple installation** "knocks out" down-time! Saves up to 50% installation time on outboard bearing drives, more when belt length isn't in stock. No resetting, tilting or moving motors. Veelos can be made any length, can be changed by adding or removing links.



NO DOWN-TIME. VEELOS FITS ANY DRIVE—WITHOUT DISMANTLING.



EACH VEELOS BELT CAN BE ADJUSTED—NO NEED FOR EXPENSIVE MATCHED SETS.



MEASURE VEELOS 1" SHORT PER FOOT AND FORCE ON DRIVE BY ROLLING. IT WON'T STRETCH.

**6. Veelos won't stretch** any more than ordinary endless V-belts when it is properly installed. Remember—measure Veelos 1" short per foot and roll on drive as tightly as possible. With the first few revolutions Veelos studs accept a permanent set into the sections they connect.

## 4 TYPES—FOR ALL DRIVES



**REGULAR**  
For general service

**OILPROOF**  
For oily and hot drives

**COATED**  
For wet or oily drives

**STATIC-CONDUCTING**  
For explosive atmosphere

For all sizes and types of drives. Double-V available for serpentine drives.

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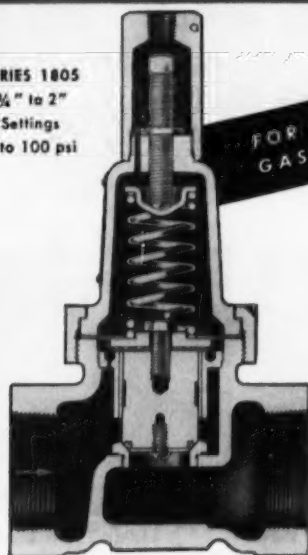
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overpressure worries!

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Sizes  $\frac{3}{4}$ " to 2"

Settings  
5 to 100 psi



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GAS RELIEF

Hundreds of plants have found Fisher compact and self-contained relief valves the answer to their relief or back pressure control problems. Whether it may be a rather unusual problem, or simply to protect your gas system for safety reasons, or possibly to relieve excess pressure from a pump, by-passing back to suction, the chances are Fisher could solve your problem. May we suggest you contact our representative in your area?

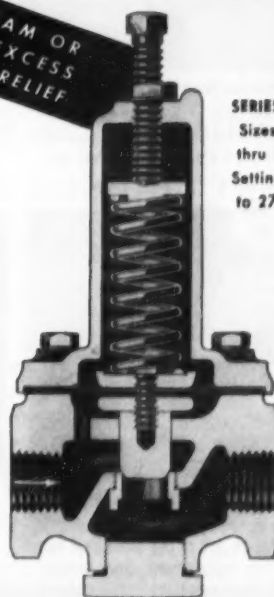
FOR STEAM OR  
LIQUID EXCESS  
PRESSURE RELIEF

**SERIES 372**

Sizes  $\frac{1}{2}$ "

thru  $1\frac{1}{2}$ "

Settings 10  
to 275 psi



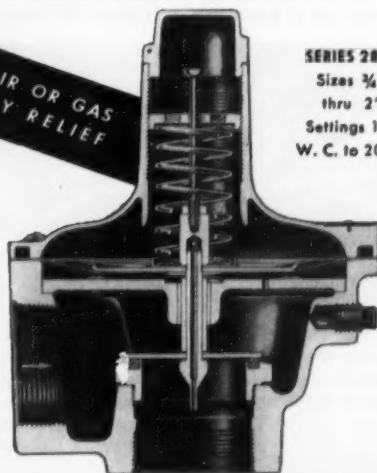
FOR AIR OR GAS  
SAFETY RELIEF

**SERIES 289H**

Sizes  $\frac{3}{4}$ "

thru 2"

Settings 10"  
W. C. to 20 psi



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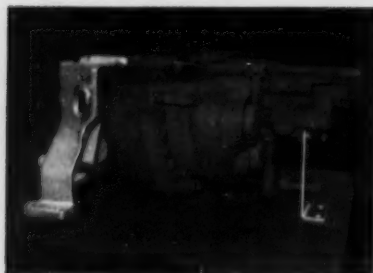
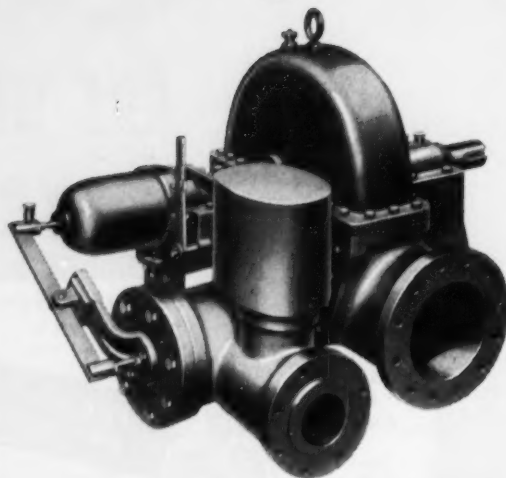
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# You're ahead 6 ways...

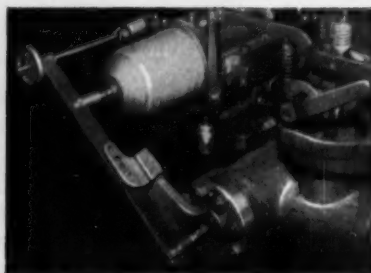
## with the ELLIOTT YR TURBINE

The simplicity and adaptability of the Elliott YR Turbine give it advantages that put it well ahead for pump, fan, compressor and other machine applications. These features all add up to the kind of long-term dependability that makes Elliott the preferred choice among plant engineers everywhere. Bulletin H-22A gives complete details. Write to nearest district office or to Elliott Company, Jeannette, Pa. for your copy.



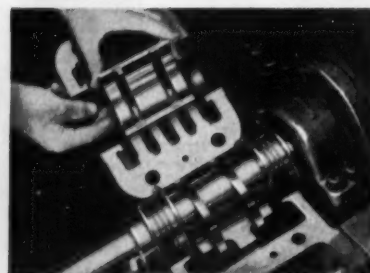
### True Centerline Support

Assures alignment cold or hot and simplifies installation. Note how the sturdy exhaust-end pedestal is separated from the hot turbine casing.



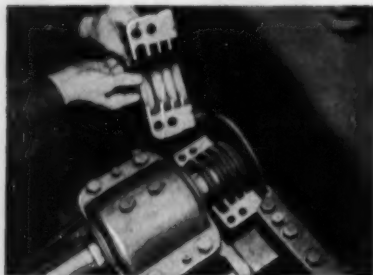
### Simple, Reliable Governing System

Weather-proofed standard governor, with fly-ball type speed-sensitive element, mounted directly on the turbine shaft, is the simplest, most rugged, and reliable type of governing.



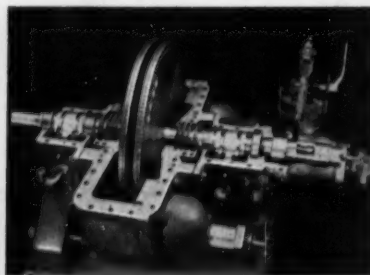
### Liner Type Bearings

Bearing cap is easily removable so that the inexpensive liner type bearing can be readily inspected or replaced. Labyrinth seals effectively protect the bearings against the elements.



### Accessible Shaft Seals

You don't have to raise the upper half of any YR turbine casing to get at the shaft seal for inspection or ring replacement. Just remove a few bolts and the steam-tight packing gland cover comes off.




### Self-Locating Rotor

Permanently fixed locating bearing makes it possible to drop the turbine rotor into perfect position without requiring adjustments.



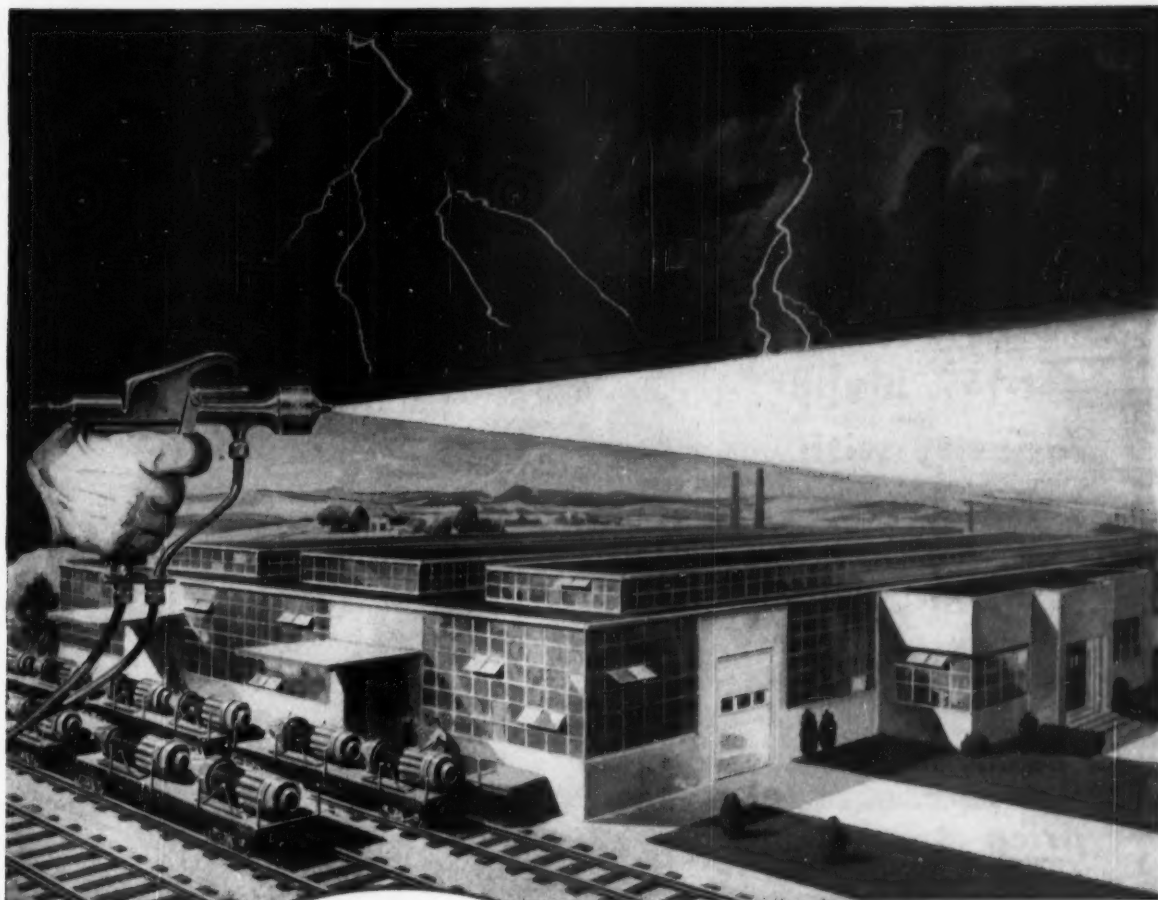
### Interchangeable Components

Renewal parts inventories are reduced by the interchangeability of wearing parts between turbine frame sizes. Possible modifications make turbines suitable for special requirements while retaining parts interchangeability.

**ELLIOTT Company** 







Spray on **PROTECTION** . . . and wipe out the threat  
of wear and weather with  
6 Exon solution resins

To wipe out corrosion by weather, rust and rot, industry looks to the performance and versatility of the 6 specifically-engineered Firestone Exon solution resins.

Formulated into compounds that can easily be sprayed, brushed, rolled or dipped, these 6 resins cover a variety of needs so diverse that virtually every coating purpose and function is served . . . effectively.

Each of the 6 Exon solution resins is engineered for a specific type of application. It may protect a product, a part, a roomful

of machinery or the outside of a plant. Some feature so powerful an adhesive grip that they hold fast for many damage-free years. Others are made to peel off clean in seconds.

All are tough, economical vinyl resins that can help save billions of dollars that management once passed off as "necessary depreciation" due to corrosion. They are a few of the many resins in Firestone's complete line of versatile vinyls. Another reason why industry looks to Exon for engineered answers to its needs.

*because  
they're made  
of*

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**VERSATILE VINYL RESINS**  
engineered answers to industry's needs

Firestone Plastics Co. supplies  
only the resins, does not  
make the finished solutions.

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**get 15% higher  
capacity with  
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pumps  
without  
increased  
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**Y**OU WANTED increased vacuum pumping capacity—and here it is. Verified by extensive performance testing, displacement ratings for Stokes Microvac pumps have been increased by 15 per cent over previously published values. This added performance is yours *at no increase in price.*

You can use the new ratings in calculating performance of Microvac pumps, and in selecting the most advantageous pump size for your application. By capitalizing on this extra capacity, you may often be able to use a smaller, more economical Microvac model than indicated by previous calculations.

Ideal for pilot plant or production processes, Microvac pumps are designed for exceptionally low maintenance. Oil leakage at the shaft is eliminated by a unique mechanical face seal. There are no stuffing boxes. Lubrication is fully automatic. Intake screen filter keeps out dirt and scale. Oil line filter protects bearings and shaft seal.

Over their entire pressure range, Microvac pumps give high efficiency . . . are widely used by themselves or as roughing pumps with booster or diffusion pumps. Call the nearest Stokes office for a consultation on your specific vacuum application.

*High Vacuum Equipment Division*  
**F. J. STOKES CORPORATION**  
5522 Tabor Road, Philadelphia 20, Pa.



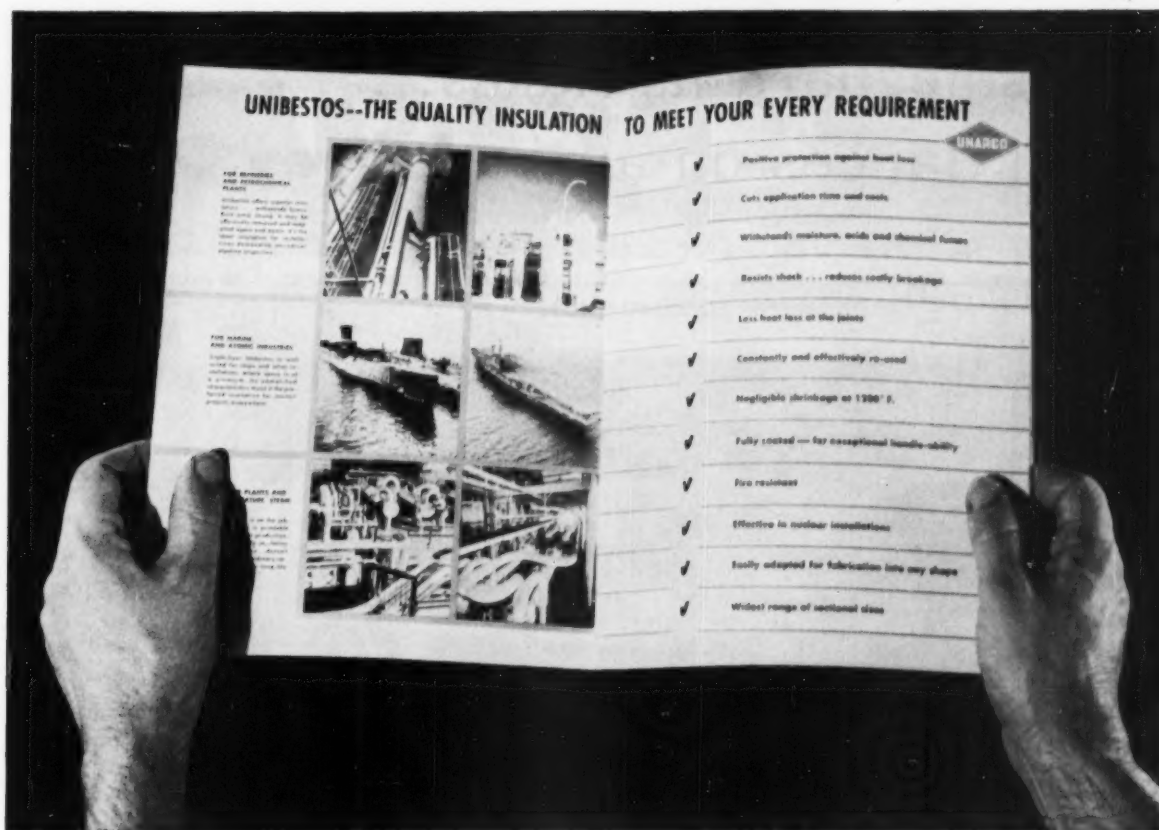
**Stokes Vacuum Calculator** contains valuable high vacuum data, simplifies calculation of pump performance and selection of pump size for specific applications. Get your free Calculator, by writing to Stokes today.



**"Stokes Microvac Pumps for High Vacuum"** tells the full story on Microvac design features . . . lists all models . . . demonstrates applications . . . explains how to calculate performance. Write for Catalog 752.

**STOKES**





## A NEW BOOK...and a new way to select pipe insulation for greatest savings

Now there's a fast, easy way to select economic thickness of pipe insulation accurately...efficiently. It's featured in the new Unibestos Catalog. This handy guidebook introduces a new simplified method based on a special "J" factor. The easy-to-use "J" index eliminates most of the complicated, time-consuming computation required by other methods.

Selecting Unibestos is a smart move, too. Made of Amosite asbestos, Unibestos® protects against heat

loss with only *single-layer application*. Strong interlacing fibers seal in more heat at the difficult joints than any other single- or double-layer insulation.

Built strong to stay strong, yet easy to miter and cut, Unibestos goes on the most difficult fittings easily... reduces application costs wherever it's used. Available in sectional form through 44" O.D.

**Write today for your copy of the new  
40-page UNIBESTOS CATALOG**



**UNION ASBESTOS & RUBBER COMPANY**  
1111 West Perry Street  
Bloomington, Illinois

Please send me the new Unibestos Catalog.

Name.....

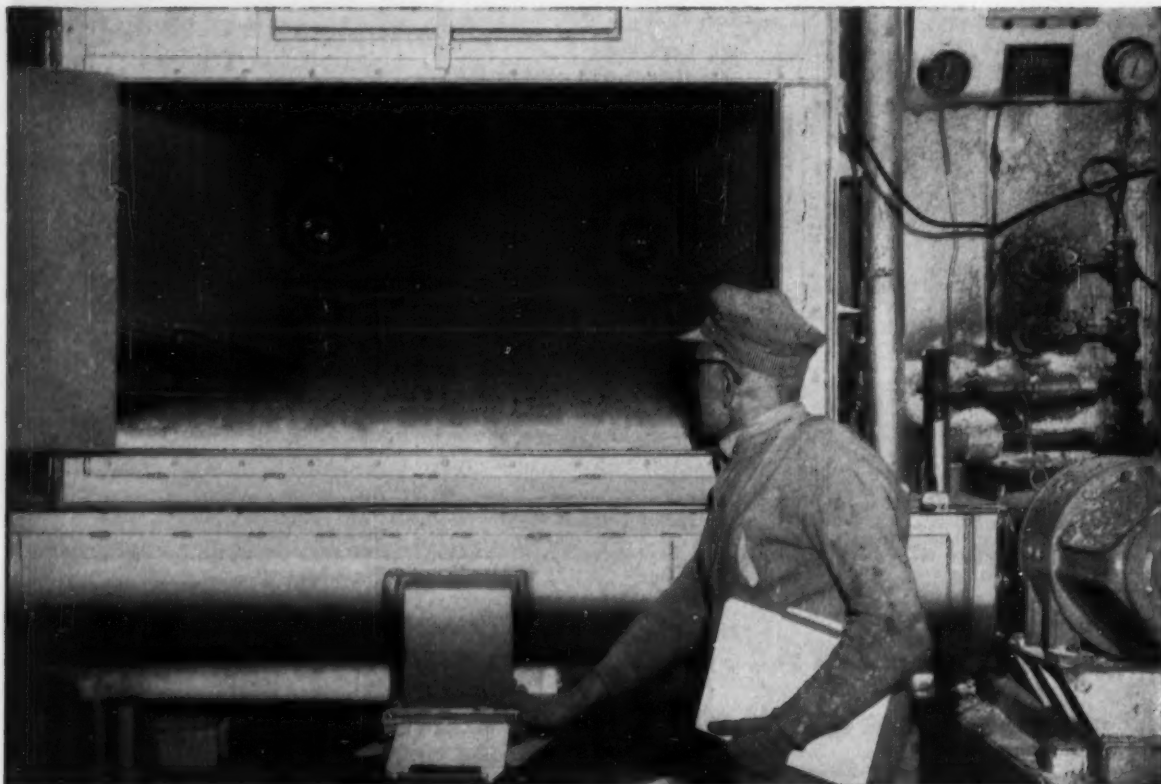
Company.....

Address.....

City..... Zone..... State.....



# to safeguard its flakes... salt dances on air in **Jeffrey Driers**



**Salt actually floats** in the air as the Jeffrey vibrating conveyor propels it through the drier, drying it to .02% moisture content.

**Salt flakes** have the high solubility demanded by butter and other quality food makers. Rotary driers, ordinarily used, tumble the salt and break up these delicate flakes. So Diamond Crystal Salt Co. of St. Clair, Michigan, adopted Jeffrey vibrating conveyor driers for this salt.

Note how the salt actually dances on air as it is gently carried through the Jeffrey drier. Thus

its flake form is preserved. Whatever your processing-conveying problem . . . drying, heating, cooling, screening, weighing . . . ask Jeffrey engineers to help solve it. If it's one that vibrating equipment can handle best, or any of the many other Jeffrey conveying methods, Jeffrey will furnish the entire system. Our engineers have a wealth of design and manufacturing know-how on which to draw.

**Catalog No. 860** describes Jeffrey conveying equipment. The Jeffrey Manufacturing Company, Columbus 16, Ohio.



## JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT  
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING





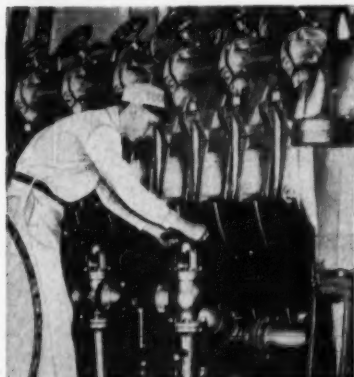
# DARCO *Digest*

CHEMICALS DIVISION, ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE

• Atlas Powder Company, Canada, Ltd., Brantford, Ontario, Canada

## TIPS ON FILTRATION

The final step in adsorption processes using powdered activated carbon is filtration, where the carbon is removed, carrying the adsorbate with it. The objective is to produce maximum flow of filtrate free from suspended carbon.



The individual carbon particles, in a properly made powdered grade, are ground small enough to give good accessibility to the internal adsorptive area, but not so small as to cause difficulty in filtration. In making powdered grades of Darco, particles are ground so that 70% pass a 325 mesh screen, and 100% pass a 200 mesh.

Flow rate of liquid through a filter is determined by the viscosity of the material you're processing. Rates may range from 2 to 3 gallons per hour per square foot of filter area for a heavy sugar liquor to 40 gallons per hour per square foot for free flowing liquids like water.

Carbon particles usually are dispersed in the liquid as agglomerates. Any action which breaks up the agglomerates will interfere with fast, clear filtration. Excessive agitation in the treatment tank will break up the agglomerates mechanically . . . especially when you have viscous liquids which will hinder re-agglomeration of the particles. This is easy to cure: Just reduce the agitation.

Or, you may run into a phenomenon called peptizing, caused by certain surface active materials which break up the carbon agglomerates into individual particles that slip through the filter. One remedy for this situation is to use filter aid both as a pre-coat, and along with carbon; also, to avoid excessive filter pressures.

Write to us for advice on your filtration problems. Our long experience may prove valuable.

## Pharmaceutical products need premium purity carbon

For purifying and decolorizing pharmaceuticals, fine chemicals and food products of many types, you require a grade of activated carbon of exceptionally high purity. The reason is evident: when taking out undesirable materials, you want to avoid introducing any new contaminants.

Darco G-60 is our premium purity grade especially manufactured for this kind of usage. Special processing gives it extremely low content of ash and solubles. Its silica and iron content are the smallest of any grade we make. And it's

premium in performance, too . . . has the best filtering properties of all Darco grades and low retention . . . a property that can save you a lot of valuable product that might otherwise be lost in the filter cake.

We recommend that you consider Darco G-60 for purification of streptomycin, sulfadiazene, and other antibiotics; for organic acids such as lactic and citric; for narcotics; and for hydroquinone, dye intermediates, nylon salts and other fine chemicals.

## IMAGINEERING with activated carbon

We've been telling you about some of the ways you can use activated carbon as an adsorbent. Carbon, however, has other talents. Because it is exposed in a large surface area, the carbon in activated carbon is an efficient reducing agent. One pound has upwards of 50 acres of effective area within its internal pore structure.

This fact leads to several useful applications. One is the removal of traces of free halogens in solution . . . for example, in water supplies. Carbon reacts with chlorine to form HCl and  $CO_2$ . Only ppm concentrations are involved, but the unpleasant taste and odor of free chlorine is effectively removed in soft drink bottling plants, breweries and numerous other industrial users of water.

Similarly, residual quantities of permanganates introduced for oxidation purposes can be removed by means of activated carbon. Potassium permanganate, for instance, is reduced by carbon to the tetravalent form, and the characteristic deep color of permanganate is eliminated due to the reduction . . . not, in this case, by decolorizing action of the carbon.

If you've got a tricky reduction problem, try activated carbon. You may be surprised at the results.





# FREE FLOWING!

*Process Lines of  
Chase Copper Water Tube  
can never clog with rust!*

**Chase**   
**BRASS & COPPER CO.**

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

Because process line joints of Chase Copper Water Tube and Solder-Joint Fittings have *no* internal projections, your pumping costs are kept to a minimum. Even heavy industrial fluids flow freely through Chase Copper Water Tube — its clean, smooth interior surface can *never* clog with rust!

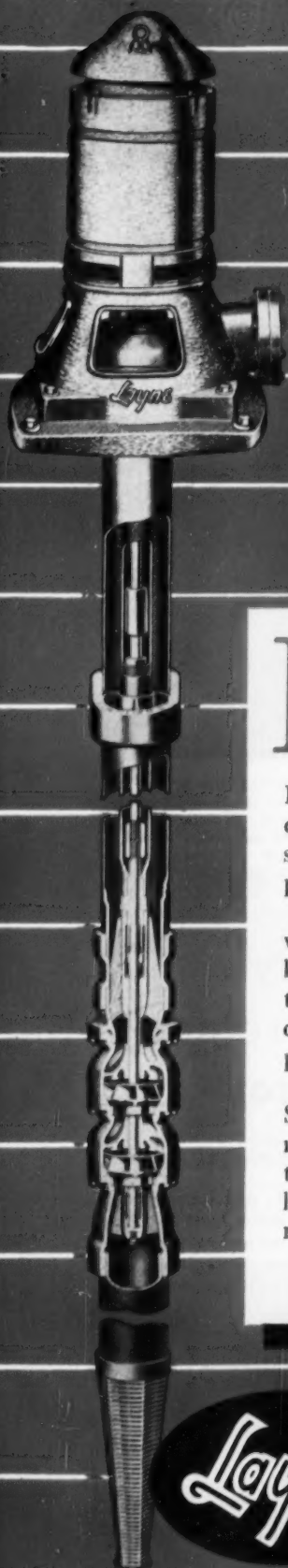
Process lines of Chase Copper Water Tube and Solder-Joint Fittings also put an end to costly repairs and maintenance. Once installed, the system stays pressure-tight, trouble-free.

Chase Copper Water Tube comes in long lengths, is easy to install, will give you years of rust-proof service. Find out more—Contact your nearest Chase Wholesaler or Chase warehouse.

*The Nation's Headquarters for Brass, Copper & Stainless Steel*

Atlanta	Chicago	Denver	Indianapolis	Minneapolis	Philadelphia
Baltimore	Cincinnati	Detroit	Kansas City, Mo.	Newark	Pittsburgh
Boston	Cleveland	Grand Rapids	Los Angeles	New Orleans	Providence
Charlotte	Dallas	Houston	Milwaukee	New York	Rochester
	St. Louis	San Francisco	Seattle	Waterbury	





## Rx Making sick wells...WELL!

First comes diagnosis. Before the cure the trouble must be known so that proper treatment may be prescribed.

Trained Layne research men, with the help of the latest and best in scientific equipment, find the trouble . . . determine the corrective measures . . . and experts go to work.

Successful? . . . One smaller Southern city saved the cost of a new well at a nominal cost. And that's just one success in a long line of sick wells that have been made well by Layne.

The nearest Layne associate company will be glad to discuss such problems with you—without obligation. It's another Layne service that proves it's always wise first to "ASK THE MAN FROM LAYNE" on any phase of water development or maintenance.

**LAYNE**  
**& BOWLER, INC.**  
**MEMPHIS**  
 General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

*Layne*



Industry



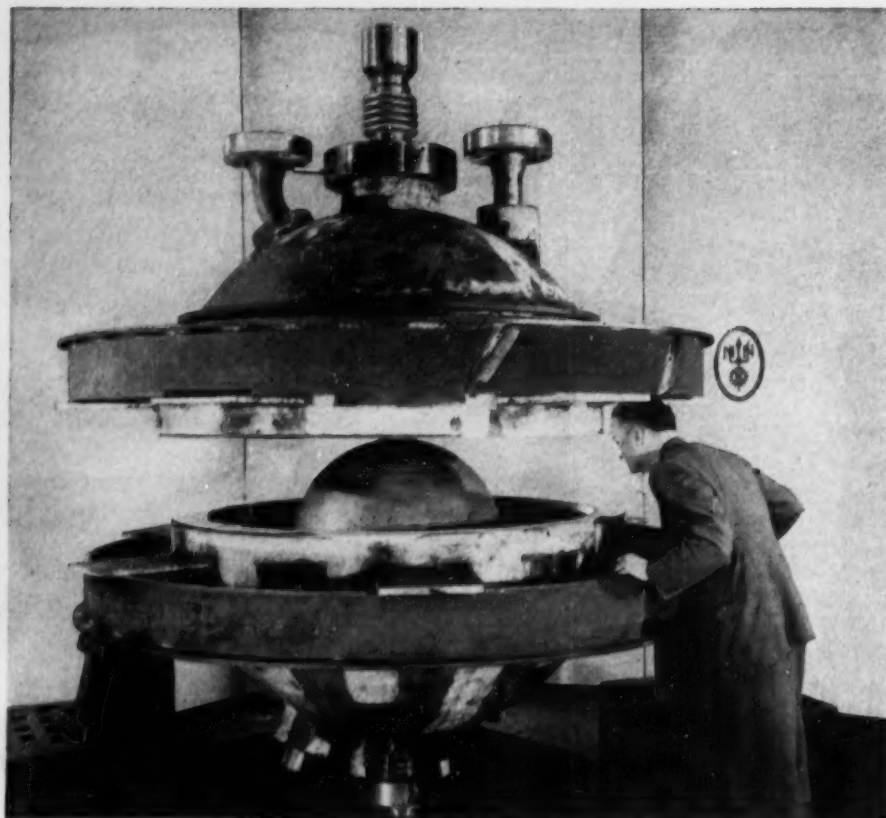
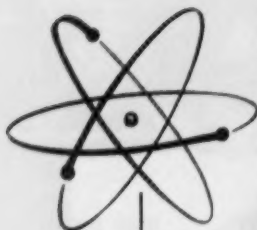
Municipality



Agriculture

Water Wells • Vertical Turbine Pumps • Water Treatment





**Assembly** of zircaloy-2 core tank and pressure vessel for Homogeneous Reactor Experiment No. 2 (HRE-2). The HRE-2 is a 5,000 KW plant designed for AEC by Union Carbide Nuclear Company. Newport News manufactured the 32" I.D. core vessel from 5/16" zircaloy-2, which involved

the development of new welding techniques. The pressure vessel of Type 347 stainless clad steel is 4.4" thick, with an inner diameter of 60". Newport News designed the expansion joint between inner and outer vessels, and also produced the unusual coil-cooled blast shield for the unit.

## **Zircaloy-2 vessel produced by Newport News...for first two-region breeding homogeneous reactor**

Never before had a pressure vessel been constructed from zircaloy-2.

Extremely active chemically, particularly at elevated temperatures, this alloy challenged fabrication. Unshielded, heated zircaloy absorbs atmospheric gases in quantities that render its corrosion and physical properties unsatisfactory. Newport News, however, achieved consistent, satisfactory welds by use of inert gas and novel, plant-developed shielding.

The core tank contains the fuel region where fissioning produces heat. The blanket or reflector region around the tank is confined by a

pressure vessel of stainless clad steel.

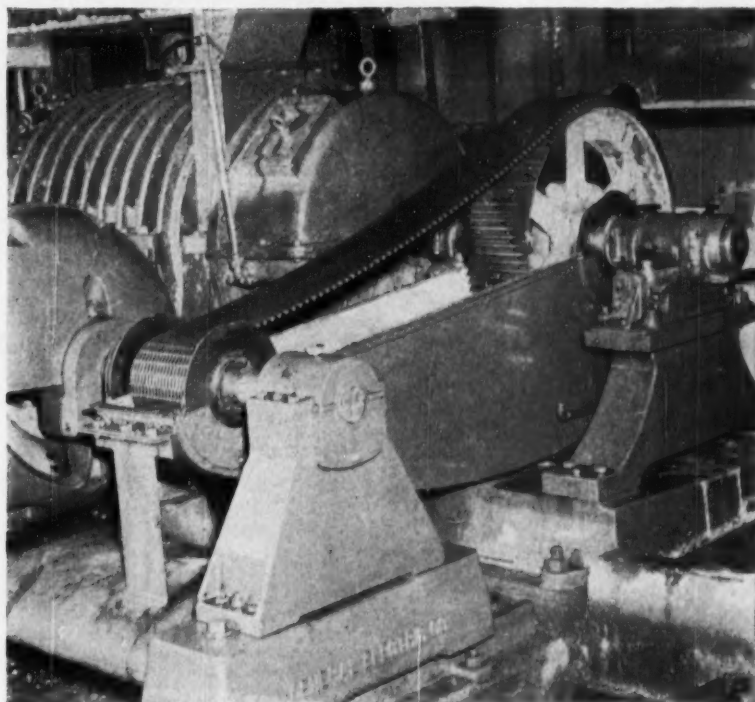
Newport News, working with its suppliers, developed special fabrication and welding techniques, as well as forge and rolling methods to produce plates and forgings with required corrosion, nuclear and physical properties for both vessels.

Make Newport News your source for fabricated metal structures. See how this company's high integration of skill and facilities can help you. Our illustrated booklet, "Facilities and Products", is yours for the asking. Write for your copy now.

**Newport News** Shipbuilding and Dry Dock Company  
Newport News, Virginia



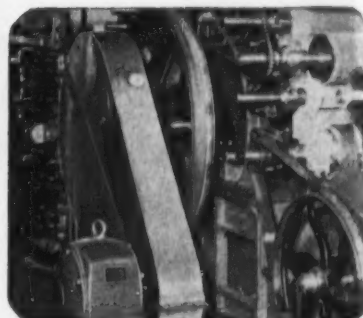
# Here's the record of LINK-BELT silent chain



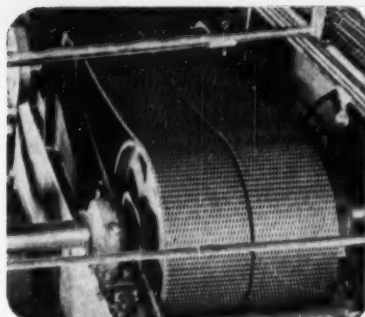
... IN SEVERE SERVICE. Link-Belt silent chain transmits power from a 100 hp motor to drive shaft of paper refiner. Link-Belt silent chain drives are often lower in

first cost, always lower in ultimate cost—due to minimum maintenance requirements, long life and positive action which eliminates power losses due to slippage.

## How do your drives compare?



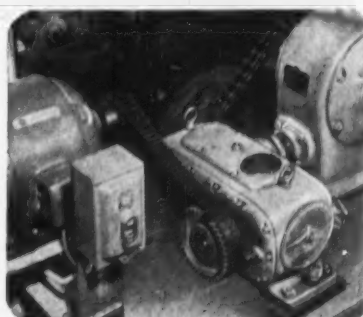
... UNDER ADVERSE OPERATING CONDITIONS. Humidity, heat, cold do not lower this chain's better than 98% efficiency.



... AT LARGE OR SMALL HP. A versatile line, these drives are available from fractional to thousands of hp.



... WITH LARGE RATIOS. Operates efficiently on extremely short centers at ratios as high as 10-to-1.



... IN LIMITED SPACE. Easy to assemble in close quarters, silent chain permits built-in drives, compact housings.



... AT HIGH SPEEDS. After 13 years on this newspaper press at speeds up to 4700 fpm, silent chain is still efficient.

For more details and advantages . . . for complete selection and technical data — ask your Link-Belt office or authorized stock-carrying distributor for a copy of 88-page Book 2425.

## LINK-BELT

### SILVERSTREAK SILENT CHAIN DRIVES

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australis, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

14,097



## How Buell's exclusive Shave-off pays off in extra dust collection efficiency

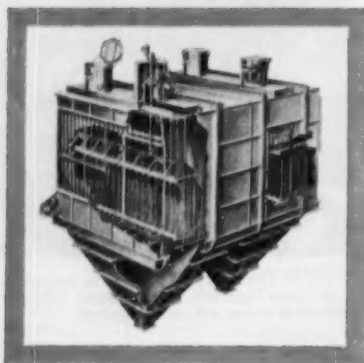
*Shave-off pays off!*

EXCLUSIVE SHAVE-OFF

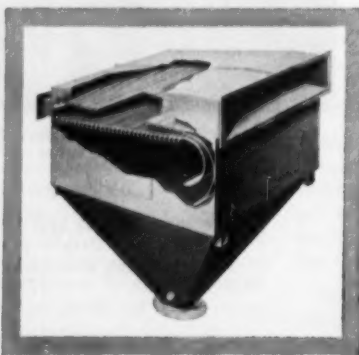
TRAPS DUST IN DOUBLE EDDY CURRENT

ADDS EXTRA EFFICIENCY!

DUST COLLECTION COSTS



Buell SF Electric Precipitator also delivers extra dust collection efficiency, due to unique Spiralelectrodes and Continuous Cycle Rapping.



Buell Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or mechanical draft installations.



For more specific data about Buell's extra efficiency, write Dept. 12-1 Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

**buell**

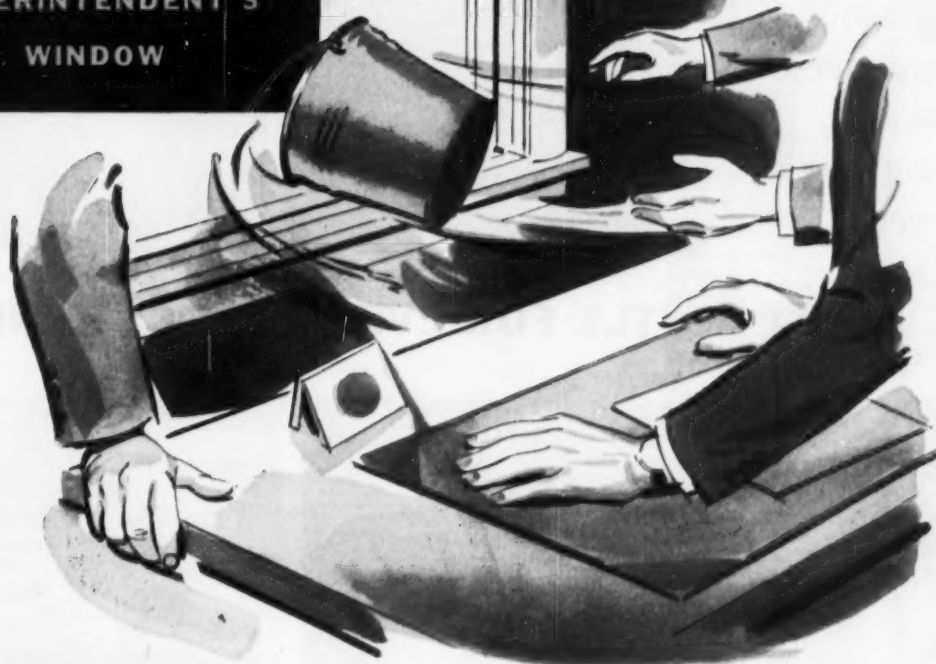


Experts at delivering Extra Efficiency in **DUST COLLECTION SYSTEMS**



HE THREW \$38.50  
RIGHT OUT THE  
SUPERINTENDENT'S  
WINDOW

A short,  
short story—  
reading time  
48 seconds



It might as well have been cash  
— If I know the "super"

My boss likes to dramatize things. He won his last argument with the superintendent by hitting him where it hurts most . . . in his budget.

We work for a feed manufacturer. I'm a chemist. The boss is mixing foreman. We're blending a small amount of vitamin supplement with bulk feed. That's it—the boss claims we're wasting most of it through improper mixing. The "Super" wouldn't approve his request for a Simpson Mix-Muller—until yesterday, anyway. Seems the boss attended our meeting armed with a bucketful of Vitamin A supplement . . . about \$38.50 worth ("Super" claims it's gold). At the proper time, he told the assembled "brass" that the bucket contained enough vitamin supplement to help fatten a whole herd of cattle—but for all the good it's doing us—and at the rate we're using it, he may as well heave it out the window . . . and he did, bucket and all.

Guess it got their attention for his arguments on how the Mix-Muller is the only mixer specifically designed to give a *thorough* blend of dissimilar and disproportionate materials. Anyway we ordered the mixer today—and a new bucket.

If you mix dry or semi-solid materials we'd like to show you why and how Simpson Mulling can do a better, faster and truly more thorough blending job. Write for our handbook, "Mulling in the Chemical & Process Industries," today and remember . . .

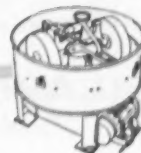


Mixing and the integration of mixing facilities is our business.



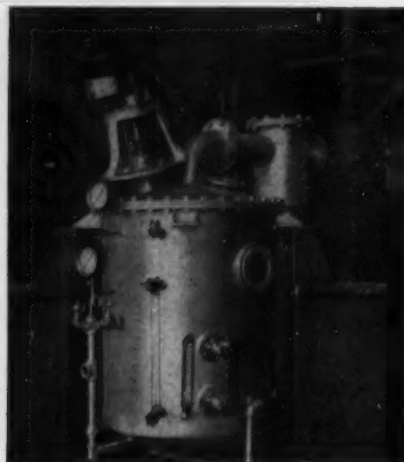
**SIMPSON  
MIX-MULLER  
Division**

**NATIONAL Engineering Company**  
636 Machinery Hall Bldg., Chicago 6, Illinois

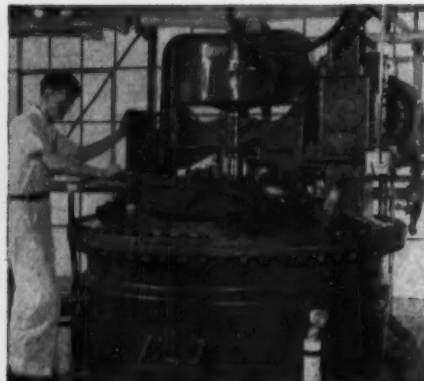
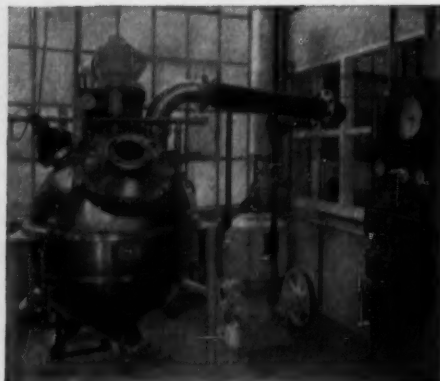
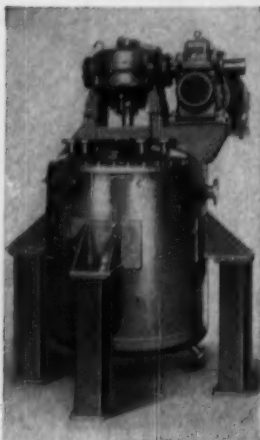




Chemicals, resins,  
grease, foods,  
pharmaceuticals,  
cosmetics,  
confectionery,  
dental and  
shaving creams,  
detergents



## THE RIGHT KETTLE FOR EVERY PROCESS NEED...



with different  
types of agitators and mixers,  
heating methods, controls

There is a *right* kettle for every processing requirement. End product, capacity desired, heat source and method, agitation and drive, and other factors determine the type and size of kettle. After about 50 years of experience in process engineering, Blaw-Knox engineers are prepared to build the kettle to your design or engineer, design and construct a kettle to fit your operations.

We invite your inquiries.

### BLAW-KNOX COMPANY

BUFLOVAK EQUIPMENT DIVISION

1551 Fillmore Avenue, Buffalo 11, N.Y.

Makers of process equipment engineered for any pressure, temperature, capacity, reaction

### A Complete Process Equipment Service

Kettles of every description constitute but one phase of Blaw-Knox Process Equipment design, engineering and fabrication service for the chemical, food, pharmaceutical, plastic and resin, petroleum, rubber and other industries:

EVAPORATION • DRYING • FLAKING  
MIXING • IMPREGNATING • REACTION  
VULCANIZING • SOLVENT RECOVERY  
SOLVENT EXTRACTION • STERILIZING  
CRYSTALLIZATION • DISTILLATION  
POLYMERIZATION • GAS CLEANING  
GAS ABSORPTION • VAPORIZATION  
CONDENSATION • HEAT TRANSFER  
LOW AND HIGH PRESSURE PROCESSING





# TAKE A GOOD LOOK...

...At The Redesigned Valve  
Body Of The New BS&B

## Super 70 series

- NEW** Streamlined flow contours provide more stable flow at all rated differentials and any inner valve position. Turbulence and cavitation are minimized.
- NEW** Accurately engineered inner valves give more exacting flow characteristics. Available in four types, top and bottom guided.
- NEW** Patented all-metal float ring seal provides positive self-actuating closure... tightens with the application of pressure.
- NEW** Forged clamp ring allows yoke orientation to any position. Requires only two bolts... eliminates annoyance of gasket replacements.

**Super "70" Series** valve bodies are available in three styles...single port, double port and split body for use in erosive or corrosive fluid service where easy removability of valve seat is desirable. All bodies can be reversed without change of parts or special tools. Split and bolted stem connector is strong, easily accessible and quickly assembled. Bolted stuffing box assembly with stainless steel follower includes spring-compressed Teflon as standard packing. Steel bodied valve dimensions are in accordance with ASA Standards B 16.5-1953.



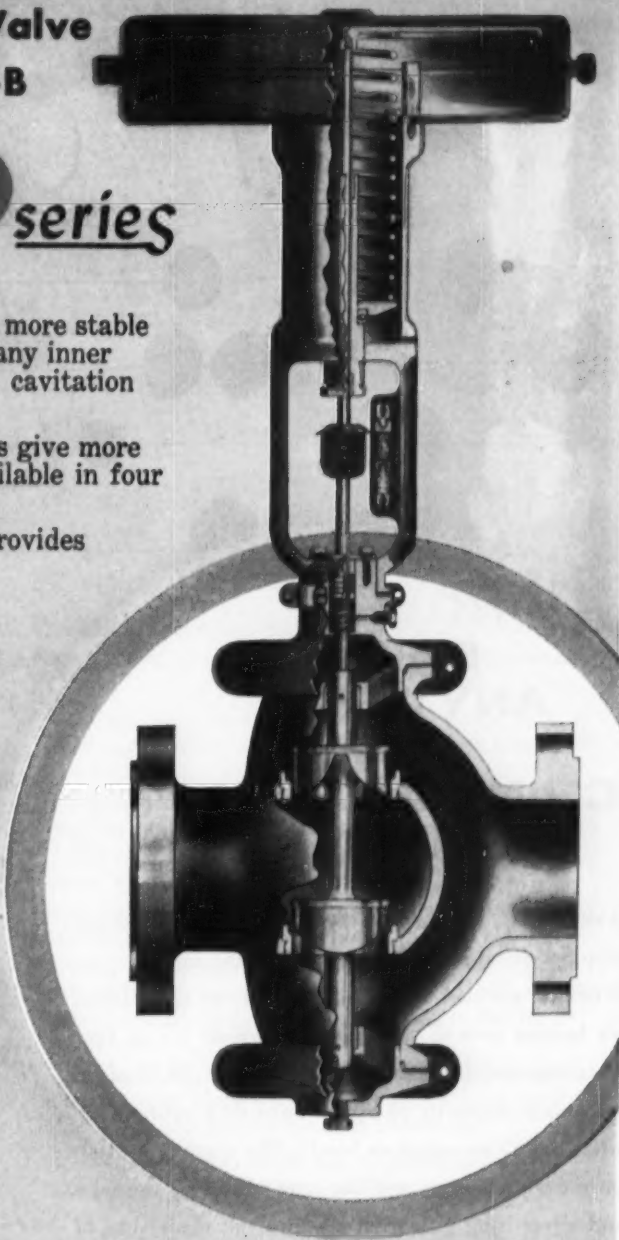
This advertisement highlights features of the Super "70" Series Valve Bodies only. Another will detail features of the Super "70" Series Topworks. Watch for it!

### BLACK, SIVALLS & BRYSON, INC.

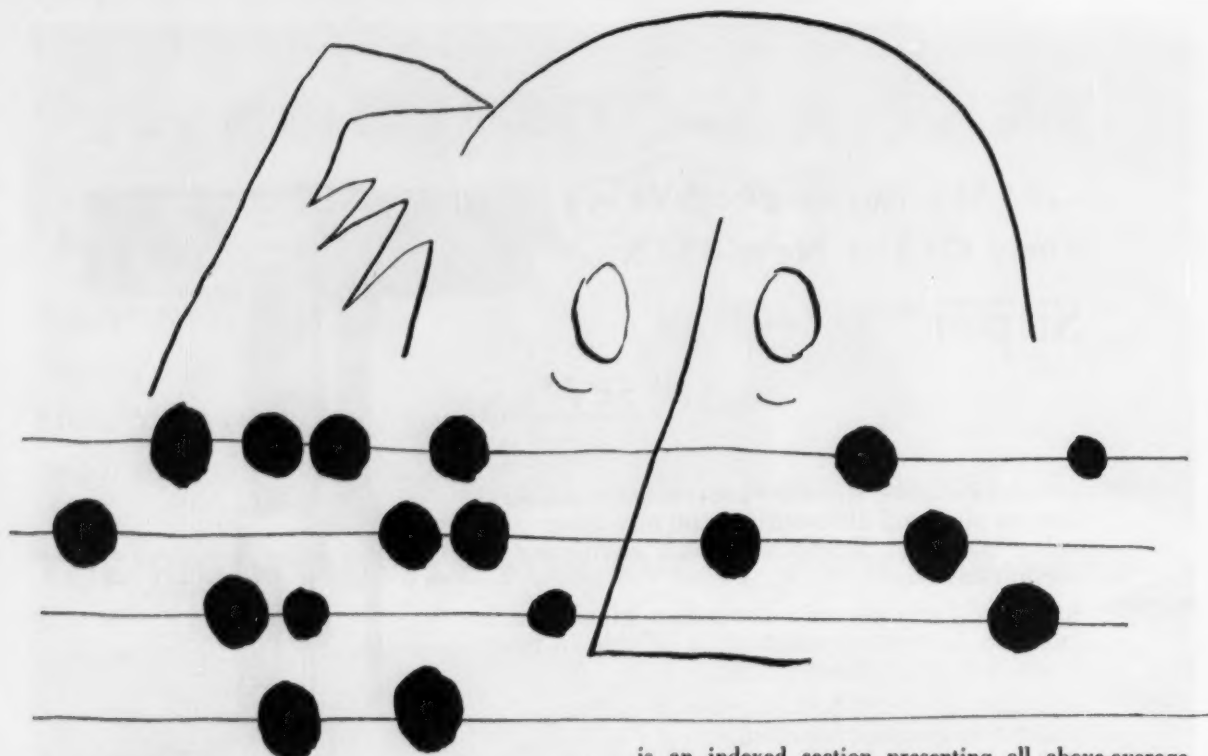
Controls Division, Dept. 4-N12

7500 East 12th Street

Kansas City 26, Missouri







## WHO SAID ANYTHING ABOUT CHINESE LAUNDRIES?

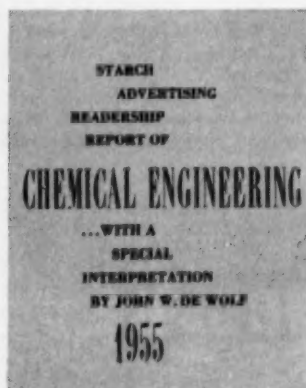
ANYWAY YOU LOOK AT IT . . . explaining Starch Readership Service isn't the easiest thing in the world.

When *we* decided to publish a booklet on the subject, we hustled over to see John W. DeWolf . . . a Vice President and Director of Research of G. M. Basford . . . and an authority on Starch (why do it yourself . . . when there's an expert on hand). The result . . . a 100-page comprehensive working manual to help the sales and advertising executive improve the readership of his Chemical Process Industries advertising . . . which we unblushingly believe is unique in the field.

The report opens with a brief discussion of what Starch Readership Service is, technique employed, its use and limitations . . . plus an interpretation of the significance of Starch advertising readership reports to the CHEMICAL ENGINEERING advertiser . . . written by Mr. DeWolf himself. Following his exacting analysis,

is an indexed section presenting all above-average Starch-rated advertisements by 10 individual product categories, that appeared in CHEMICAL ENGINEERING during 1955.

To evaluate new copy and art techniques . . . to see how your CPI advertising stacks up against competition . . . let us send you a personal copy of this helpful booklet. Address on company or agency letterhead: Director of Research, CHEMICAL ENGINEERING—CHEMICAL WEEK.



**CHEMICAL ENGINEERING**

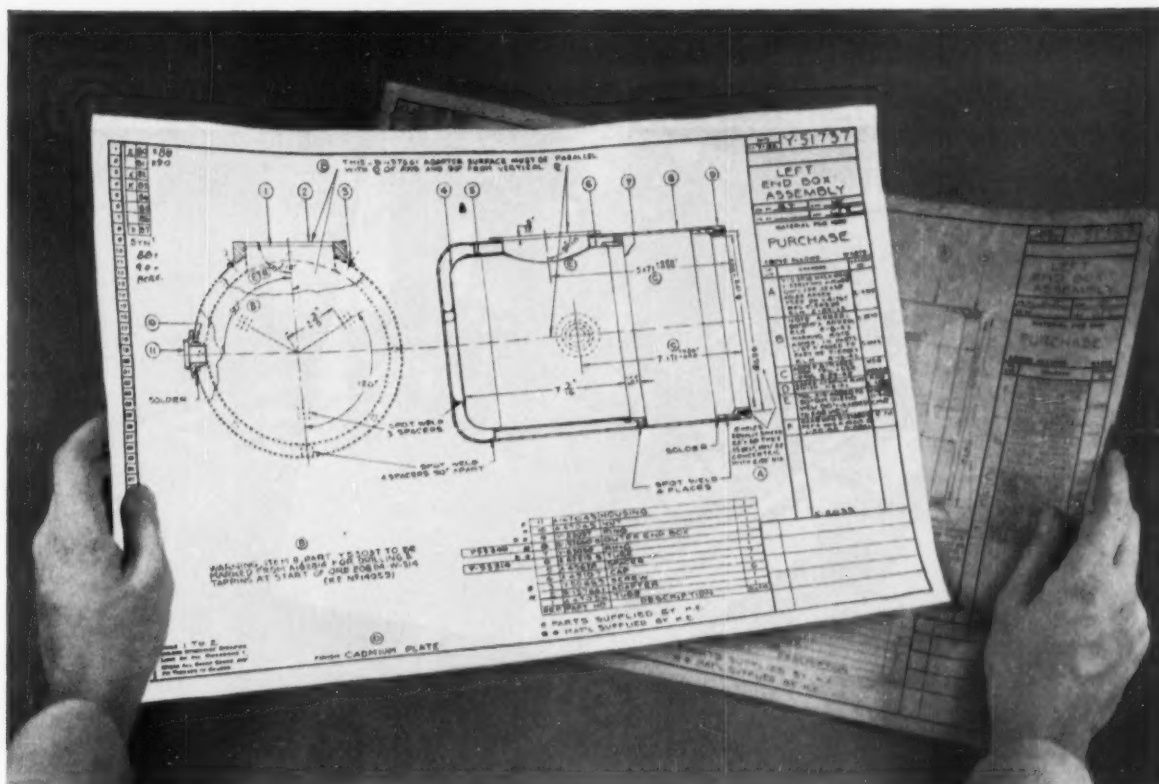
*...for engineers in all functions*

**CHEMICAL WEEK**

*...for management in all functions*

MCGRAW HILL PUBLICATIONS (ABC—ABP) 330 WEST 42 STREET, NEW YORK 36, N. Y.





This Autopositive Paper intermediate was made from an old, "yellowed" drawing

## To restore old drawings without retracing a line

Take one of your old pencil drawings that is so worn and yellowed it will no longer produce acceptable prints.

Reproduce it on Kodagraph Autopositive Paper, and you'll get a positive reproduction directly.

Now run prints from this photographic intermediate. You won't believe your eyes—the lines are crisp, legible... the background wonderfully cleaned up. *These* are prints you can use!

With Kodagraph Autopositive Paper around, it just doesn't pay to waste hours retracing "unprintable" originals, as thousands of drafting rooms have discovered.

Learn all the ways you can save with Kodagraph Reproduction Materials, which you, or your local blueprinter can process quickly, at low cost.

**EASTMAN KODAK COMPANY**

Graphic Reproduction Division, Rochester 4, N. Y.



New booklet is jam-packed with valuable tips on saving drafting time, protecting drawings, getting better prints.

## Kodagraph Reproduction Materials

MAIL COUPON TODAY

EASTMAN KODAK COMPANY

105-12

Graphic Reproduction Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new booklet on Kodagraph Reproduction Materials.

Name \_\_\_\_\_ Position \_\_\_\_\_

Company \_\_\_\_\_

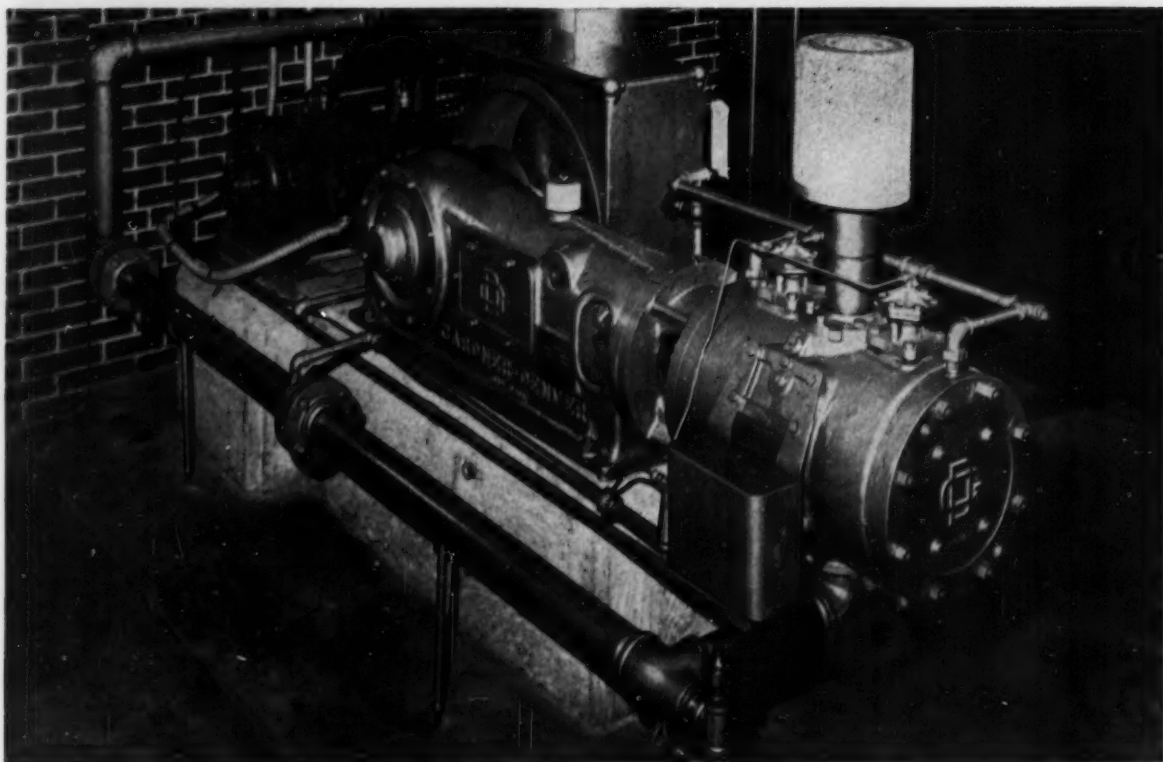
Street \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**Kodak**  
TRADE MARK



**Gardner Denver . . . Serving the World's Basic Industries**

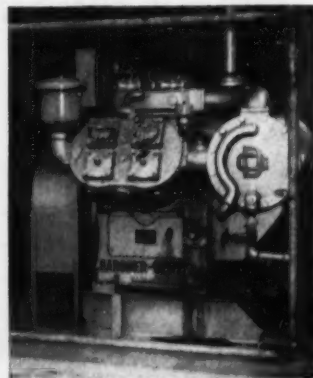


## **Oil-Free air with no maintenance penalty . . . Gardner-Denver Carbon Piston Compressors**

Pure, oil-free air that's safe for textiles, plastics, foods, beverages, automation instruments. Low-cost air that's economical for maintenance tools and regular plant operation.

You get *both* from the Gardner-Denver CRX Carbon Piston Compressor.

Self-lubricating carbon, used for pistons and other parts, does away with any need for oil in the cylinder. Yet, user reports show that cost per cubic foot of air compressed by the CRX matches usual compressed air costs. There's no maintenance penalty—no need for two separate compressed air systems in your plant. Send for Bulletin CRC-10 today.



Another popular industrial compressor . . . the compact, efficient Gardner-Denver WB.



## **GARDNER - DENVER**

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS  
FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois  
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curly Avenue, Toronto 16, Ontario



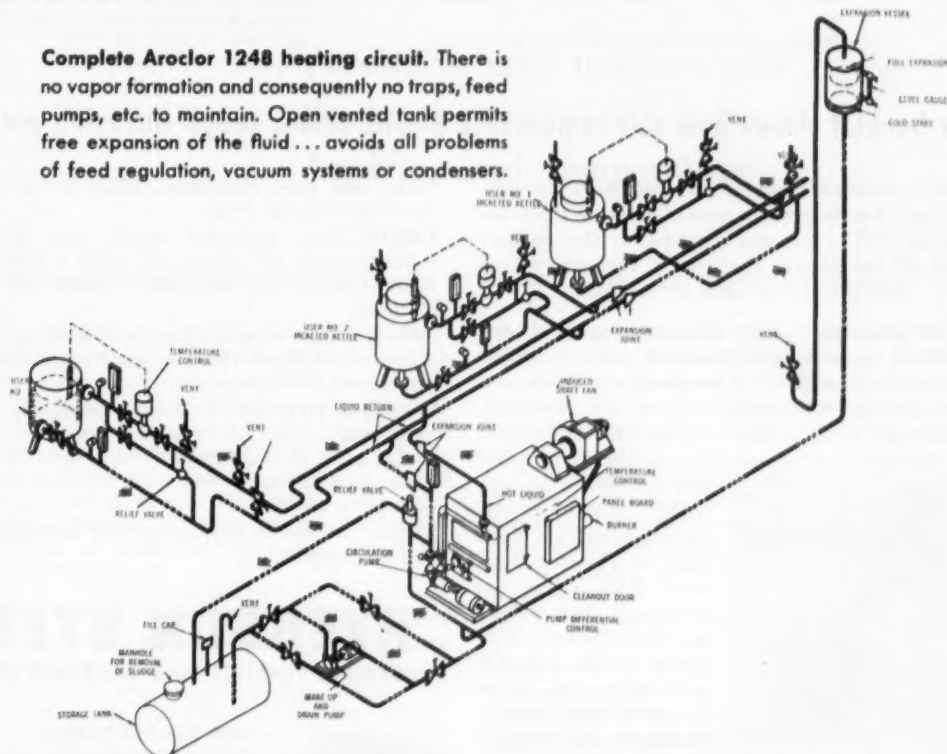
Now . . . **NON-PRESSURIZED** liquid-phase heat systems that operate up to **600°F.**

# AROCLOR 1248

**Operates at atmospheric pressure**...cuts installation and maintenance costs of expensive pressurized systems.

**Fluid is fire-resistant**...increases safety by eliminating direct-firing, or heat transfer with flammable fluids.

**Complete Aroclor 1248 heating circuit.** There is no vapor formation and consequently no traps, feed pumps, etc. to maintain. Open vented tank permits free expansion of the fluid... avoids all problems of feed regulation, vacuum systems or condensers.



**The Equipment**... capacities can range from small portable units—usually electrically heated—to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Circuits are closed, forced-circulation. Compact design saves space, minimizes installation and maintenance costs.

**The Fluid**... Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725° F.; has autogenous ignition temperature of extremely high 1299° F.; is non-corrosive. Aroclor 1248 operates in most systems four to seven years without replacement.

## MONSANTO

Where Chemistry Works Wonders For You

### Contact Monsanto for SOURCES of AROCLOR 1248 heating systems

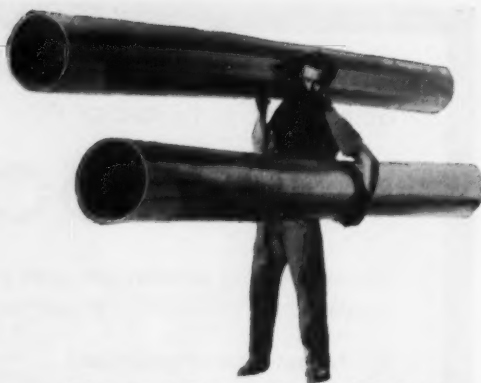
Write to us on your company letterhead. We will send you technical information about Aroclor 1248 and/or the names of Aroclor 1248 heat-transfer system manufacturers and designers. Organic Chemicals Division, MONSANTO CHEMICAL COMPANY, Dept. IF-2, St. Louis 1, Missouri.

AROCLOR: Reg. U. S. Pat. Off.



# NEW FACTS ON PVC

(POLYVINYL CHLORIDE PLASTIC FOR PAPER MILL APPLICATIONS)

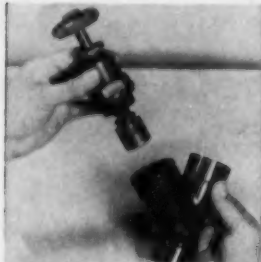


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Injection molded globe valve of Ryertex-Omicron PVC. The same smooth finish on the inside assures maximum flow.

flow resistance are detailed. Maximum operating pressures of all sizes of Ryertex-Omicron PVC pipe are given and their weight per foot listed. (The plastic weighs only 1/6 as much as steel—1/2 as much as aluminum.) In short, the booklet answers hundreds of questions about how Ryertex-Omicron PVC may solve your toughest corrosion problems.

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In chemical processing, Ryertex-Omicron PVC is recommended for: Tanks and tank linings, troughs, pipe lines for liquids or gases, fumes systems, blowers, roof ventilator housings, chutes, filter plates, splash covers, neutralizing acid equipment, cutter and drains, settling towers and scrubber towers—to name just a few of many applications.

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TOOLS FOR TOMORROW . . .

# High Temperatures

- . . . Producing high temperatures
- . . . Containing high temperatures
- . . . Applying high temperatures

A three-part symposium reported by N. K. Hiester, A. W. Searcy and Leo Brewer\*

**D**URING the past three years there have been many significant advances in high temperature technology. Spurred on by parallel developments in rockets, nuclear reactors and chemical processes, high temperature studies have progressed beyond the basic research stage. Now chemical engineers, as well as physical chemists, metallurgists and physicists, are hard at work on the many-sided problem of producing, containing and using high temperatures.

It is certainly true that if our Heat Technology Report of June 1953 had been published today it would have devoted much more space to the high end of the temperature spectrum.

This lusty engineering interest in high temperatures was well illustrated by the surprising attendance at the joint Stanford Research Institute-University of California High Temperature Symposium held at the latter's Berkeley campus last June (*Chem. Eng.*, Aug. 1956, p. 104). Where the co-sponsors had expected perhaps 200 attendants, it was necessary to shift to larger quarters to accommodate the more than 600 who registered. Perhaps of even greater significance was the fact that nearly every national chemical company sent at least one representative.

What did they mean when they spoke of high temperature? As a guide in preparing papers the co-chairmen agreed initially on the range of 2,000 to 200,000 C. as the range to be covered. But as Dean Kistler of University of Utah's College of Engineering pointed out, high temperature is relative. In today's nuclear reactor technology, 1,000 C. is beyond the range of most present investigations. In the process field the metallurgists and ceramicists are looking for alloys and

ceramics useful under process conditions at 2,000 C. The shock-wave phenomena of the physicist really begin to be significant only above 20,000 C., while other physicists are approaching 1,000,000 C. with short-lived electrical discharges.

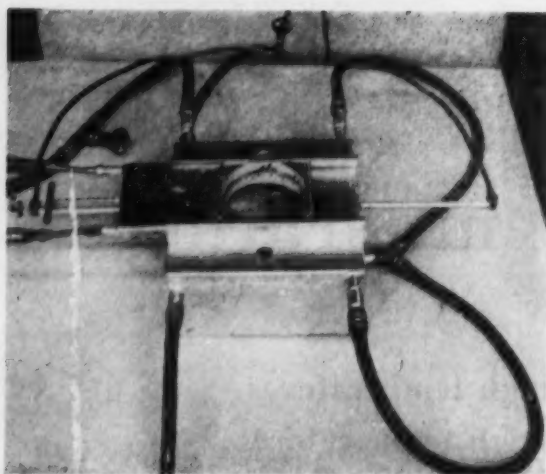
Accordingly, although temperatures below 2,000 C. and above 50,000 C. were discussed, the principal focus of the symposium was on the temperature region above that of present-day technology, but still presumably attainable by tomorrow's.

The symposium accomplished its expected purpose of bringing together many experts to discuss the directions that high temperature research should follow. Participants brought forth a maximum of speculation with a minimum of recapitulation and presented many ideas in a minimum of time. There were, in fact, so many new ideas that even the conferees will not have gained the full benefits of the meeting until they have studied the final Proceedings.

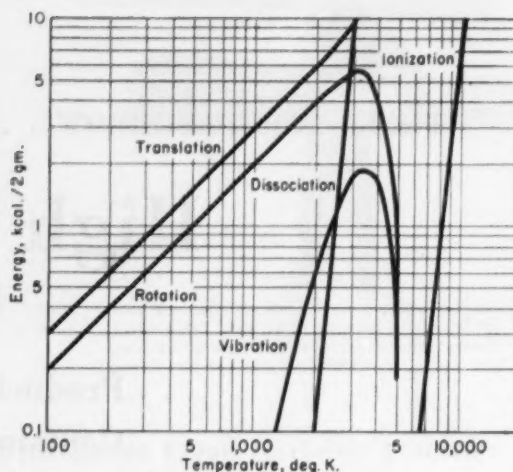
To bring our readers the gist of this important meeting of minds Elliot Schrier, western editor of *Chemical Engineering*, arranged to have each of the three co-chairmen—Nevin Hiester, Alan Searcy and Leo Brewer—write an interpretive summary of the more thought-provoking papers presented before his particular portion of the symposium. Furthermore, to top it off, Dr. Hiester and two of his SRI colleagues are preparing a full-fledged *Chemical Engineering* Report for our March 1957 issue, to deal with the engineering aspects of high temperature methods, materials and processes. For it is true that engineering advances, especially in the field of high temperatures, are following research with startling rapidity.—Editors.

\*Meet your authors on pp. 402-4.





DIRECT furnace uses aluminum as fuel, burning in oxygen.

DISSOCIATION limits chemical heat release ( $H_2$ , 1 atm.).

## TOOLS FOR TOMORROW—High Temperatures . . .

### . . . Production

NEVIN K. HIESTER, Stanford Research Institute.

High temperature methods, materials and processes are strongly interdependent. Some of the methods for attaining high temperatures involve chemical processes or reactions which in turn require special materials to confine them. And many of these special materials can be made only through high temperature processes based on methods calling for the materials themselves. It's like the old problem of the chicken and egg.

**Image Furnaces**—One way of breaking the vicious circle is to use a method unaffected by these limitations. And one such method is to use optical images of very high temperature sources. In image furnaces the material being heated can serve as its own crucible, since the heat flows outward rather than inward. Joseph Farber, of General Electric Co., pointed out that among the other advantages of this type of heating is the absence of electrical and magnetic fields and of contaminating atmospheres.

The temperature achieved at the image is, of course, a function of the material being irradiated, its geometry, emissivity, and heat losses. Although the sun behaves

as a black-body emitter of around 5,700 C., the highest temperature achieved in solar furnaces to date has been of the order of 3,200 C. Farber feels that 3,700 C. is probably the upper limit of solar furnaces, because of energy losses in the atmosphere, losses in reflection and losses due to the fact that the concentrator is never a geometrically perfect paraboloid. And T. P. Davis, of the University of Rochester, feels that equally high temperatures can be achieved in high intensity arc-image furnaces, since the electrode vapors irradiate at about 5,500 C. black-body temperature.

According to Davis, arc-image furnaces convert only about 1% of the input of electrical energy to final thermal flux at the image. Added to electrical and other losses, there is only about a 70% conversion of electrical energy into radiation, and a very large percentage of this is directed backward and cannot be focused.

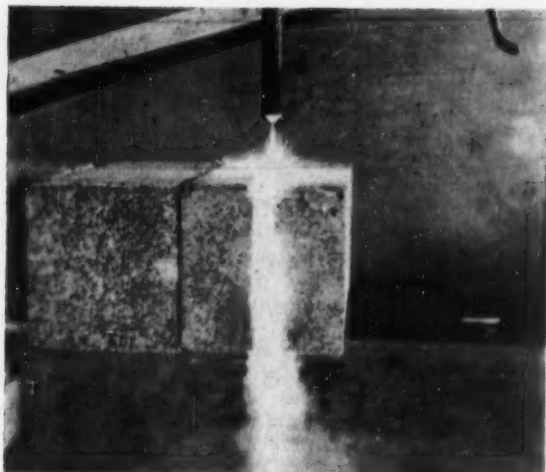
However, he has been able to up his electrical conversion efficiency to nearly 20% by using essentially no concentrator at all. According to his comments during the discussion period, he uses a light

pipe, 3½-in. inside dia. and 6 in. long, with water jacketed walls. The arc is at one end, with an airblast to deflect the arc tail flame away from the assembly. The sample is exposed in the plane of the further end of the pipe, which aluminized inside.

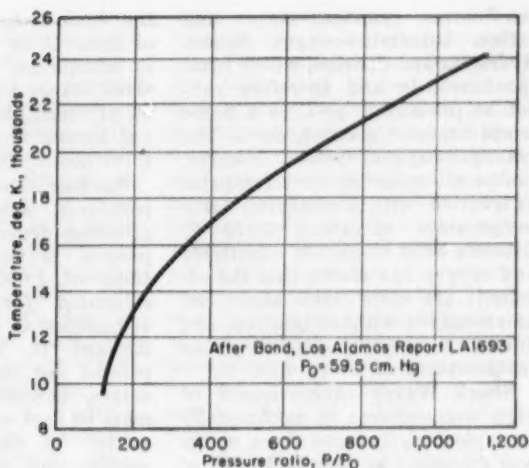
**Direct Furnaces**—John M. McGreevey, of New York Naval Shipyard, also suggested using no optics at all; that is, he puts the material to be heated near the radiating source and permits it to receive its energy directly. One such furnace, developed jointly with Temple University's Aristad V. Grosse, is illustrated above. Oxygen and an aluminum rod are fed into the furnace, resulting in a pool of liquid aluminum floating on a layer of aluminum oxide previously formed during the run. Combustion takes place in the cloud of aluminum vapor just above the molten aluminum, and the brilliant aluminum lake provides an irradiance of nearly 20 cal./sq. cm./sec. near the furnace, with a brightness temperature of about 2,900 C.

That ubiquitous material, graphite, is usually involved in all three types of electric furnaces (resistance, induction and arc). As long as a reducing or neutral atmosphere can be tolerated, it permits attainment of the highest temperatures. Graphite resistance furnaces can achieve over 3,000 C. rather easily, graphite induction furnaces, nearly 3,500 C. When an oxidizing atmosphere is involved,





OXY-ALUMINUM torch cuts bricks, concrete, metals.



ARGON reaches high temperatures behind a shock front.

however, oxide-type resistors and inductors must be used. MacPherson described a thoria base refractory oxide-type resistor that can achieve over 2,000 C.; Norton Co.'s Gordon Finlay pointed out that some of the other refractory oxides have also been used as heating elements, but all suffer from fragility and thermal shock and require auxiliary heating to perhaps 1,700 C. or better before they become satisfactory conductors.

**High Intensity Discharges**—One of the unique methods of using electrical energy is the high intensity arc in which the current density is 100-400 amps./sq. cm. (compared to about 40 amps./sq. cm. in commercial arc furnaces). Here the positive carbon is rapidly evaporated, forming an anodic vapor flame that has a radiation equivalent to that of a black body of 5,500 C. Wolfgang Finkelburg, of Siemens-Schuckertwerke AG, pointed out that the thermal plasma temperatures of such a flame can reach from 12,000 C. to somewhat in excess of 50,000 C.

Finkelburg especially stressed the unique properties of the thermal plasma—that is, the electrons and ions formed in the arc. For example, at 30,000 C. nitrogen gas contains 60% free electrons, with the remaining particles about evenly divided between singly and doubly ionized nitrogen atoms—all neutral atoms have practically disappeared. The electrical conductivity of the gas rises from insulation values to a specific re-

sistance only twice that of metallic mercury—it becomes an excellent electrical conductor. We thus now have four states of matter.

Another unique use of electrical energy is the technique involving short-time electrical discharges as described by Heinz Fischer, of Cambridge Research Center. He has been able to achieve gas temperatures of over 250,000 C. in helium under 30 atm. at pulse lengths of about one micro-second, with a pulse about every 10-20 sec.

Fischer also mentioned that the Russian scientist Igor Kurchatov, in his Harwell lecture last spring, reported temperatures of 1,000,000 C. in deuterium plasma at sub-atmospheric pressures by generally the same technique.

**Combustion Processes**—There is, of course, a continual search going on for chemical reactions providing the highest flame temperature. Jet Propulsion Laboratory's David Altman pointed out that for such combustion situations a real barrier exists—one that can be called the "chemical barrier." Under a given set of conditions, this barrier represents the temperature range in which dissociation of molecular species occurs, thereby destroying the source of heat release. This is shown in the plot on p. 174, which represents the percentage distribution of energy in molecules as translation, rotation, vibration, dissociation and ionization for hydrogen at 1 atm. and various temperatures. The chemical barrier is represented by the region

between 2,700 and 4,700 C. where the rotational and vibrational energies eventually become negligible due to dissociation.

Altman also discussed the energies of some typically strong chemical bonds. Triply bonded nitrogen and doubly and triply bonded carbon monoxide have the most energetic bonds known. This provides a clue for selection of chemical reactions to yield maximum flame temperatures, namely the choice of unstable reactants involving only the elements: carbon, oxygen and nitrogen at a carbon-to-oxygen atom ratio of one-to-one. The reaction of cyanogen and carbon subnitride to produce carbon monoxide and nitrogen yields the highest flame temperatures reported, thereby corroborating the conclusion from bond energies.

During the last eight years, the Research Institute of Temple University has been investigating chemical methods for the production of high temperatures in the range of 3,000-6,000 C. Aristad V. Grosse described a considerable amount of this work, a major portion of which was concerned with combustion of metals. He pointed out that an oxy-aluminum torch has been developed which can be used to cut holes in brick, concrete and various other materials, and certain metals which cannot be cut with an oxy-acetylene cutting torch. The torch is shown above.

Another area of research described by Grosse is the combustion of gases. He studied hydro-



gen-fluorine, cyanogen-oxygen and carbon subnitride-oxygen flames. Hydrogen and fluorine, which react spontaneously and therefore cannot be pre-mixed, produce a flame temperature of about 4,030 C. The cyanogen-oxygen system, however, can be pre-mixed in the torch prior to ignition, with a measured flame temperature of about 4,370 C. Grosse's work on carbon subnitride and oxygen has shown that the reactants are quite stable alone, can be pre-mixed without ignition, and during combustion provide flame temperatures of about 4,990 C.

**Shock Waves**—Achievement of high temperatures in mechanically or explosively induced shock waves was discussed by George Duvall of SRI. In mechanical systems the shock wave is produced in a long metal tube divided into two sections by a thin diaphragm. The gas to be studied is introduced into the low pressure section and the driver gas in the high pressure section. When the diaphragm is ruptured, a compression wave moves into the low pressure region ahead of the interface between the driver gas and sample gas.

The explosive technique is the only practical one for producing shock waves in solids and liquids. Here, the shock wave is set up by the detonation of a pad of explosive of uniform thickness which moves a metallic "driver plate."

Duvall quoted temperatures of 18,000-24,000 C. achieved behind

the shock front in argon (p. 175), of 2,000 C. in water, and 1,500 C. in aluminum. Passage of strong shock waves through air serves to fix nitrogen. Explosion of a nominal atomic bomb is estimated to form about 100 tons of oxides.

**Nuclear Processes**—The temperatures achieved by nuclear processes depend upon whether the process is controlled. Temperatures of 1,000,000 C. have been estimated for fission reactions, 100,000,000 C. for fusion reactions. Richard H. Graham, of AEC, pointed out that in operating reactors, however, the temperature must be kept within the limits permitted by current materials of construction, which must not only withstand high temperatures, but also be noncorroded by the working fluids, be unaffected by irradiation fields, and finally, have the proper nuclear cross-section properties. Pressurized water reactors are now operating successfully at about 350 C., and liquid-metal-cooled reactors at about 850 C. AEC is examining the possibility of developing reactors for high temperature chemical processing, aiming initially at 1,400 C.

Graham pointed out that one possible heat transfer mechanism to ease design problems is the Nernst effect. Gaseous molecules could be endothermically dissociated at the heat exchanger wall and returned to process to re-associate and give up their energy.

can be prepared under special circumstances may eventually lead to new practical alloys. These materials show essentially the strength predictable from their bond energies, while ordinary metals and alloys show less than one-tenth their calculated theoretical strengths. Such ultra-strong materials might have high strength even at temperatures close to their melting points. The remarkable strengthening effect of small amounts of carbides in high strength steels may be due to high crystal perfection in the carbide particles similar to that in the "whiskers."

**Ceramics**—Several of the speakers pointed out that ceramic materials often show a reasonable amount of ductility at temperatures near their melting points, suggesting that if failures during thermal cycling can be avoided ceramics may find a wider range of utility. In particular, it may be possible to employ ceramic materials for one-time-use apparatus, such as missile components, by carefully pre-heating the part before service.

Earl R. Parker, University of California, suggested another point of attack on the problem of increasing the utility of ceramics. Alkali halide crystals show a very significant degree of ductility when subjected to tension in unsaturated aqueous solutions. Similarly, after treatment with surface active agents, cakes of ice can be subjected to a 15° bend before failure. Parker said that these and related experiments prove that surface conditions markedly influence the mechanical behavior of at least some inorganic materials and that an understanding of the factors involved may well lead to development of ductile ceramics.

Ceramic materials often show remarkably high impact resistance and mechanical stability when present as thin coatings. Armour Research Foundation's Samuel W. Bradstreet summarized the remarkable progress in development of new coatings and coating techniques during the past few years. Among the more interesting new techniques is that of flame spraying, which deposits a cohesive layer of oxide on a surface, with little heating of the surface. Recent work has yielded a true protective coating. The flexibility of the coating

## TOOLS FOR TOMORROW—High Temperatures . . .

### . . . Containment

ALAN W. SEARCY, University of California.

More often than not, discussions at the symposium ultimately returned to the ubiquitous problem of obtaining satisfactory structural materials for high temperature operation. As operating temperatures are raised it becomes not only difficult to find materials which are chemically inert, but even difficult to find those which have satisfactory mechanical properties. Metals tend to lose tensile strength rapidly above 800-1,000 C. Ceramic materials have poor impact resistance and often poor thermal shock resistance as well.

**Metals**—John C. Fisher, of General Electric Co., analyzed the various mechanisms of failure in metallic materials and pointed out that virtually all become increasingly serious with increased temperatures. He suggested, however, that one particular kind of failure, cavitation fracture, may be controllable by identification and suppression of the intergranular sites where nucleation of cavities occurs.

Fisher also expressed the opinion that additional study of the extremely strong "whiskers" of iron, silicon and other materials that



method with respect to application and possible substrate compositions suggests a wide range of commercial flame-sprayed coatings.

A method of using thermodynamic data as a guide for obtaining improved coatings through careful control of the coating atmosphere was outlined by Ivor E. Campbell, of Battelle Memorial Institute. By holding the activity of the coating material at a level high enough to permit reaction with the surface, but too low to permit deposition of the unreacted coating material, coating could be limited to the sites where the vapor species had not yet attacked or had attacked and diffused inward.

**Refractories**—Many coating processes under investigation already require use of materials near the melting points of the most refractory solids. The need for a wider variety of high melting materials is therefore acute. John T. Norton (MIT) directed attention to the fundamental chemical factors which result in materials of very high melting points. He demonstrated that high melting materials can be divided into two distinct classes: (1) Compounds characterized by saturated electron pair bonding (silicon carbide and aluminum nitride), and (2) compounds of certain transition elements with such non-metals as carbon, silicon and boron. Norton believes that the predominant factor in producing this second class of materials is a filling of the *d* shells of the metal atoms. Boron phosphide might prove a useful refractory of the first class, and ternary compounds, such as Ta-C-Si combinations, might yield melting materials of the second.

The effects of high pressures on the structure and properties of refractory materials were discussed by both University of Utah's Dean Kistler, and H. Tracy Hall, of Brigham Young University. Most startling of their comments was Hall's statement that the melting points of certain refractories have been raised more than 1,000 C. by application of pressure. Such materials melt with an increase in volume. On the other hand, increased pressure lowers the melting points of substances that melt with a decrease in volume. The melting point of germanium has been lowered 600 C. by application of pressure. Very probably, solid-

liquid critical points exist and will soon be experimentally observed.

**Other Approaches**—Several other approaches to the problem of containing high temperatures were described. Tibor S. Laszlo, Fordham University, directed attention to the possibility of using "self-containers" with such heating sources as solar furnaces and arc image furnaces. Such furnaces direct a very intense heat flux into a small area so that it's possible to melt poor thermal conductors such as oxides locally in a larger sample of the same material.

Carnegie Institute of Technology's C. Law McCabe suggested the possibility of avoiding reactions of molten salts with their containers in salt-molten metal systems by containing the salt inside a layer of the rotating liquid metal. And Westinghouse Research Laboratory's J. C. R. Kelley reported progress in levitation heating of metals by suspension of the metals in electromagnetic fields.

**Radiation Effects**—Because the efficiency of all types of nuclear

reactors can be increased by raising the operating temperatures, the importance of the effects of high energy radiation and fission product accumulation on high temperature structural materials is obvious. Since present reactor designs involve rather moderate temperatures, almost no work has been done so far on the behavior of materials at high temperatures in the presence of nuclear fission. There is some information on the effects of radiation on different types of materials at room temperature, however. This information was summarized by GE's Clifford Weber.

Very high melting materials, because of the slower diffusion of fission products in such materials, may be desirable for use in parts which will be operated only at moderate temperatures. The advantage of lower diffusion rates, however, might be at least partially offset by the higher temperature to which relatively low thermal conductivity ceramic materials would be heated in the reactors.

## TOOLS FOR TOMORROW—High Temperatures . . .

### . . . Application

LEO BREWER, University of California.

Discussion of high temperatures in chemical processing inevitably includes the accompanying problems of the reactions of the materials of construction with the process chemicals. An attempt was made at the symposium to distinguish between equilibrium and kinetic problems, but the distinction was often difficult to apply. Studies of the rate of attack on solids by gases, for example, have normally been carried out by kineticists; investigators primarily interested in equilibrium processes, however, have been forced to investigate the kinetics of evaporation of condensed materials.

**Theoretical Relationships**—An example of the power of theoretical examination of high temperature chemical problems was provided by Hall's calculation that known thermodynamic data for graphite and diamond and known kinetic data for conversion of diamond to graphite prove that graphite cannot

be converted directly to diamond in any temperature-pressure range achievable by any conceivable means.

Max Bredig, of Oak Ridge National Laboratory, discussed present knowledge concerning mutual solubility of a metal with its salts. At present available data seem to eliminate the existence of any solid sub-halides of alkali or alkaline earth metals. The mutual solubility of these metals with their halides, however, is remarkably high; miscibility is sometimes complete just above the melting point of the higher melting constituent.

Many speakers emphasized the need for more complete and more accurate information. Several speakers, including John L. Margrave (University of Wisconsin), Russell K. Edwards (ITT), Paul W. Gilles (University of Kansas), and Richard F. Porter (Cornell), stressed the importance of com-



plete knowledge and understanding of all possible reactants and products. They illustrated this point with many examples of unexpected high temperature gaseous species, such as  $\text{Ba}_2\text{O}$ ,  $\text{Ba}_3\text{O}_2$ ,  $\text{B}_2\text{O}$ , and  $\text{Be}(\text{OH})_2$ .

It's probable that presently unknown complex species in fused salt melts will prove as important as these unusual gas species. Ervin R. Van Artsdalen, of Oak Ridge, suggested that formation of complex ions in fused salts should be expected to influence equilibrium concentrations in manners entirely analogous to the effects of complexing in aqueous solutions. Accordingly, complexing phenomena may be useful in inhibiting molten salt attack on containers and in controlling the rate of deposition of elements plated from molten salt solutions.

Several speakers emphasized the importance of fluid phase transport phenomena in influencing reaction rates at high temperatures. The dramatic catalytic effect of certain oxides in increasing the rate of oxidation of metals was discussed by Stanford Research Institute's Daniel Cubicciotti. He explained that low melting oxides, such as  $\text{MoO}_3$ ,  $\text{WO}_3$ , and  $\text{V}_2\text{O}_5$ , probably serve as liquid phase carriers for transfer of oxygen from the gas phase to the surface of the metal. Oxide additives that form solid products with these liquid oxides reduce their catalytic effects.

Both Cubicciotti and C. Law McCabe described instances in which a solid phase with very low solubility in a liquid may be attacked by the liquid over a long period of use, even if only a relatively slight temperature gradient exists. The solid then may be dissolved at the temperature of higher solubility and reprecipitated in parts of the apparatus at temperatures of lower solubility. An example of such a process cited by Cubicciotti is the transfer of iron through liquid mercury. Small additions of substances such as titanium and aluminum greatly reduce the mass transfer of iron by mercury.

McCabe suggested that solids might be purified by subjecting them to temperature gradients. Through the Soret effect this should cause dissolved impurities to migrate much the same as in purification by zone melting.

**P-T Relationships**—Perhaps the most important single contribution to high temperature research in the past few years has been the development of the apparatus called the "Belt" in which synthetic diamonds were made by Hall and associates at GE. While Hall predicts commercial production of synthetic diamonds within three years, the most significant aspect of the GE work is not the diamond synthesis itself but the new dimension for high temperature research added by the apparatus. Phenomena that occur at pressures of 200,000 atm. and temperatures as high as 5,000 C. may now be investigated. Unfortunately, for the time being, at least, the "Belt" has been classified by the Government.

The general effects of combined high temperature and high pressure on chemical reactions are well worth further investigation. A pressure increase of 100,000-200,000 atm. is equivalent energy-wise to a temperature increase of 1,000-2,000 C.; both require energies of the order of those occurring in chemical reactions. Pressure increases, however, usually have an effect opposite to that of temperature increases. For example, at very high pressures the degree of disorder in a system is reduced and materials approach zero entropy just as they do at very low temperatures. Furthermore, high pressures reduce the rates of chemical reactions because of the inhibiting effect of the high pressures on movement of particles. Thus, liquid viscosities are increased by increasing pressure to the point where it should be possible, Hall predicts, to use materials which are mobile liquids at normal pressures for container materials in very high pressure experiments.

It's well known that pressure increases normally favor reactions that produce substances of lower total volume. In practice, however, it's possible to carry out certain reactions that take place with an increase in volume at high pressures. Specifically, reactions that produce hydrogen are favored in the very high pressure apparatus because hydrogen diffuses readily through the lattice of the containing metal and escapes.

The new range of high temperature and high pressure combinations now available will certainly lead to synthesis of a vast variety

of new materials. Kistler remarked that a new form of silica has been produced simply by compressing quartz above 80,000 atm.; Hall reported the preparation of coesite, a recently discovered modification of silica, by direct conversion from quartz at 2,000 C. under about 100,000 atm. Both Hall and Kistler suggested that new materials of high hardness will be made by high temperature-high pressure synthesis. Finally, in the new high pressure-high temperature range now available, it may be possible to make many familiar substances into new electronic configurations. Hall believes, for example, that a metallic modification of ammonia will be produced soon.

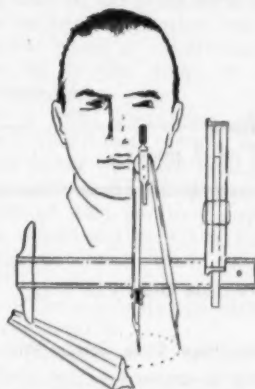
**Processes**—At least two processes which do not at first appear to involve high temperatures can profitably be thought of as high temperature processes. One such process is the passage of recoil fission products through nuclear fuel elements in which the measured temperature may be only a few hundred degrees C. Atoms along the paths of recoil may be heated to temperatures as high as 10,000 C. for an extremely small fraction of a second. The effects of such intense, but brief, local heating are not well understood.

Grinding is the second hidden high temperature process. Kistler pointed out that during grinding the points of contact are heated to temperatures in the order of the melting points of the materials involved. Hence, reactions can be expected between the surfaces. He attributes the superiority of aluminum oxide over silicon carbide for grinding ferrous alloys to alumina's lower reactivity toward the alloy constituents. But silicon carbide is better for grinding oxides owing to lower oxide reactivity.

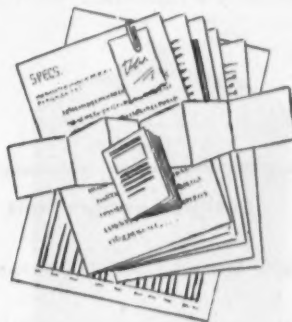
As was expected, more questions were raised than answered at the meeting. Clearly, in the field of high temperature research, much remains to be done. But equally clearly, nuclear reactor and jet engine development will continue to provide a tremendous impetus to development of high temperature materials. And, from the research connected with these programs, high temperature chemical processing, already an important segment of the economy, is bound to receive a spectacular boost. This aspect will be covered in the forthcoming March Report.



## Data Sheet Bridges the Gap...



Between Purchaser and Builder



...Saves Time, Money and Grief

# How to Buy Pressure Vessels

If you want to get a well-engineered pressure vessel there must be mutual understanding of the purchaser's requirements and the builder's problems. Here's how you can bridge the gap between them.

**R. W. SCHNEIDER, Travelers Insurance Co., Hartford, Conn.\***

You can find a considerable amount of descriptive information and experimental data in the literature on the design of pressure vessels. Codes have been published that illustrate sound design and construction principles. These codes are based upon the results of fundamental research and they have been proven satisfactory by the cumulative experience of the pressure vessel industry.

However, use of this reference material alone does not assure the purchaser of a "well-engineered" pressure vessel. The purchaser must be able to convey his principal requirements to the fabricator before the codes, handbooks, literature—and even the designer's experience—can be applied effectively and accurately.

To us this may be an obvious conclusion. Nevertheless, the purchaser-supplier relationship is often

strained because of the lack of mutual understanding of each other's problems and requirements.

For example, a fabricator is often asked to supply a vessel for 100 psi. at a maximum temperature of 300 F. Also, let's presuppose that the size of the vessel has been established. The question is, "Are these the only conditions upon which a sound design depends?"

They may be, but the omission of a seemingly unimportant condition could completely alter the problem with the result that the vessel may not be satisfactory for its intended service.

To illustrate this point, consider the case where the pressure may be cyclic. Here we might have to consider fatigue.

In another example the minimum operating temperature may be -75 F., in which case the low-temperature toughness of the material of construction would become an im-

portant consideration. These are just a few of the points that must be considered when you prepare for the purchase of a well-engineered pressure vessel.

### USE A DATA SHEET

There are innumerable other points—some quite subtle and often overlooked—which, if not conveyed to the fabricator, could result in a pressure vessel that would not be entirely suitable for its intended service.

One way for the purchaser to convey his basic requirements to the fabricator is by means of general design notes on the drawings or better still, by means of design specifications made a part of the purchase contract.

A sample sheet of design specifications is given on the next page to cover the case where both design and fabrication will be done by the supplier. Most of the usual basic

\* Meet your author on p. 405



## The Pressvess Company

Engineering Department

Written by: \_\_\_\_\_

Date: \_\_\_\_\_

Approved by: \_\_\_\_\_

Date: \_\_\_\_\_

Date Issued: \_\_\_\_\_

Page 1 of 2 pages

### Design Specifications

**1. Design Specifications**

The specifications supplement purchaser's Sketch No. A-2345 and form a part of Purchase Order P.O. 7777.

**2. Construction**

The vessel shall be designed and built in accordance with the ASME Unfired Pressure Vessel Code, Section VIII, 1952 Edition, latest addenda, and shall be suitable for installation in the State of \_\_\_\_\_.

**3. Drawing Approval**

The fabricator shall supply the purchaser with two sets of shop drawings for approval in advance of fabrication. The purchaser's approval shall in no way relieve the fabricator of the responsibility of conforming in all respects with the design specifications. If any of these design specifications or Sketch No. A-2345 conflict with the requirements set forth in Par. 2 above "Construction" the fabricator shall advise the purchaser of same and revised Sketch No. A-2345 may be issued.

**4. Inspection and Stamping**

The vessel shall be inspected and stamped in accordance with the requirements of the ASME Unfired Pressure Vessel Code, Section VIII. The vessel is intended for use in the State of \_\_\_\_\_ and accordingly the inspector shall hold a commission for such inspections recognized by the State of \_\_\_\_\_.

**5. Design Conditions**

Design Pressure—100 psi. to atmospheric.

Design Temperature—From minus 20 F. to plus 650 F.

Corrosion Allowance—1/16-in. throughout.

Contents of Vessel—Water.

**6. Welding**

All welds shall be of the double-welded butt type or equivalent. All nozzle welds shall be full penetration.

**7. Stress Relieving**

Not required.

**8. Radiography**

All circumferential and longitudinal welds shall be spot X-rayed in accordance with the provisions of the applicable code.

**9. Testing**

The vessel shall be hydrostatically tested in accordance with the requirements of the applicable code. The purchaser shall be notified three days in advance of testing so that his inspector may, at his option, inspect the completed vessel and witness the subject test.

**10. Supports, Ladders, Platforms and Other Appurtenances**

None required.

facts and the oft-overlooked subtle points are included.

However, with a few minor revisions, the sample may be applied to the case where the purchaser provides the supplier with complete detail drawings suitable for construction purposes. Let's examine the items in the sample specifications one-by-one and see why they are important.

**DESIGN SPECIFICATIONS**

In order that the design specifications form a part of the purchase contract they should be specifically referred to on the purchase order or on one of the drawings listed therein.

**CONSTRUCTION**

Certain states and cities of the U.S. require that pressure vessels

be designed and built according to a recognized code, for example the ASME Unfired Pressure Vessel Code.

If more than one code of the same name exists, then the year or edition should be specified.

In some instances states and cities have their own boiler and pressure-vessel codes in which case this would appear in the design



specifications. In case the local requirements are not known, the regulatory body of the state or municipality having jurisdiction over the particular vessel or installation can advise as to the scope of such requirements.

For a brief discussion of the over-all ASME code picture, we refer you to the foreword in any one of the various ASME codes. The question of state and local requirements should not be taken lightly and the purchaser of a pressure vessel is cautioned to give this phase of the purchasing problem his full consideration.

Your own insurance company will be able to tell you whom to contact for such information.

#### DRAWING APPROVAL

In many cases the purchaser provides the supplier with rough sketches. This statement permits him to review the fabricator's shop drawings in advance of fabrication to check that the specifications have not been misconstrued.

Possibly the information in the sketches or in the specifications conflict with the construction requirements set forth in Par. 2. In this case it is stated that the construction requirements take precedence and shall not be waived or altered without specific approval.

While the purchaser's requirements may often be more rigid than the minimum requirements of the applicable code, less rigid or contradictory requirements must be brought to the attention of the purchaser.

In this particular example "Construction," Par. 2, is the focal point and subsequent paragraphs merely eliminate certain design options which the code permits and which could otherwise be used by the fabricator.


#### INSPECTION, STAMPING

It's possible to have a vessel designed and fabricated in accordance with a certain code and yet it may not be suitable for its intended use. The statement on the sample specifications precludes this possibility. Now let's see why.

In addition to the provisions given under "Construction" certain states and cities require that a vessel be inspected and stamped by an inspector holding a commission recognized by that particular state.

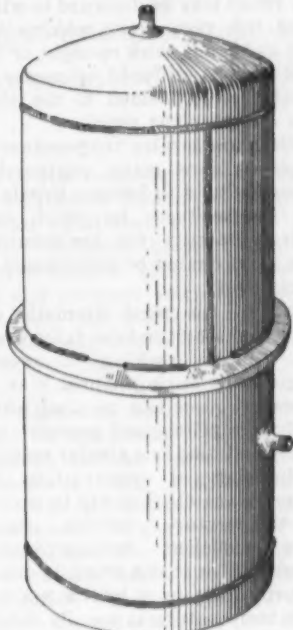
Obviously the only way a fabrica-

**This Vessel Collapsed Under External Pressure**



Just at the point of collapse, this experimental vessel is beginning to deform at those areas outlined by the dotted white line. A flat area can be seen at the right center of the vessel at the point of initial instability. But don't always expect to see a flat spot! In most instances, if instability of this type occurs, the collapse is sudden re-

**Here's How It Might Have Been Prevented**



quiring major repairs to recondition the vessel.

Vessels may be designed to withstand full vacuum by making the shell and heads thick enough; or the shell may be stiffened by means of circular rings welded to the shell. A ring such as that shown above might have strengthened the shell enough to prevent collapse.

tor can conform to this requirement is by the purchaser advising him as to the destination of the vessel. This is an important consideration and warrants close attention.

#### DESIGN CONDITIONS

The specification sheet should provide basic information which defines the service conditions of the vessel.

Under "Design Pressure" a minimum pressure has been indicated in addition to the maximum pressure. At first this information may appear to be unnecessary. However, the reason for its inclusion will be evident if we consider that it is not uncommon for a vessel to collapse even though it has been designed

adequately for its internal pressure conditions.

A vessel may operate satisfactorily for years under internal pressure and then collapse suddenly while it is being emptied. Needless to say, the occurrence comes as a surprise. But actually at this point a vacuum developed and the vessel was subjected to external pressure—a condition for which it was not designed.

This type of failure usually occurs on larger vessels designed for low internal pressures. These vessels have relatively thin shells and consequently little stability when subjected to external pressures.

Devices are available for prevent-



ing the formation of a vacuum, but the point is that the possibility of this occurrence must be recognized while the vessel is in the design stage.

A vessel may be designed to withstand full vacuum by making the shell and heads thick enough; or the shell may be stiffened by means of circular rings welded to the shell (see box previous page).

Minimum service temperature is specified since many engineering materials tend to become brittle at low temperatures in which case their suitability for low-temperature service must be ascertained by special tests.

One of the most dramatic examples of a brittle-type failure was the sudden cracking of several cargo ships during World War II. However, cases can be cited where bridges, pipelines and pressure vessels have failed in a similar manner.

Materials of construction for pressure vessels that will be used in low-temperature service should have sufficient low-temperature toughness so that a crack is unable to propagate in a brittle manner. Low temperature is usually defined as -20 F. or below.

Similarly, other design features must be incorporated for vessels intended for low-temperature service. Notches such as punch marks,

scratches, gouges and undercutting along welded seams must be eliminated. They are potential crack starters. Workmanship for low-temperature vessels should be of the highest quality.

Maximum temperature is specified since design stress (used in computing the wall thickness) is a function of elevated temperature.

If extra material is required by the purchaser to compensate for the corrosive action of the contents, it should be so stated or the applicable code may require a corrosion allowance depending on the contents.

There are other cases when the fabricator must be advised of the contents. For example, vessels which are to contain lethal substances must have all main welded seams of the double-welded butt type and be completely X-rayed.

#### WELDING, STRESS RELIEF, X-RAY

In most codes, design options exist. All of these options may not be equally suitable for a particular vessel. If this is the case, the specifications must be explicit or the fabricator may use his discretion within the broadest limits that are established.

#### PRESSURE TESTING

The statement in the sample design specification sheet is self-ex-

planatory and requires no discussion.

#### SUPPORTS, LADDERS, ETC.

If ladders or platforms are to be attached to a pressure vessel, it is preferable that consideration be given to these and other appurtenances while the vessel is still in the design stage. Ladders and platforms are frequently bolted to lugs and clips which are welded to the shell of the vessel.

When appurtenances are welded to the shell of the vessel they are considered to be a part of the vessel and must conform to the requirements of the applicable construction code. If the appurtenances are omitted during construction and installed in the field by the purchaser or his subcontractor, an examination of the completed work may be required by an inspector described in Par. 4, "Inspection and Stamping."

Other costly complications can arise. If the construction code requires heat treatment the vessel may have to be stress relieved upon completion of welding. This can be a costly operation when performed in the field.

In any event it would represent a double expense since the vessel had already been stress relieved by the fabricator.

There are many obvious omissions in the sample design specifications which might have been mentioned but since each problem has many ramifications, a more complete analysis would have been of questionable value.

It is not the intent of this paper to develop a standard purchasing form but to investigate briefly some of the basic—and some of the obscure—points that are often overlooked when buying a pressure vessel.

A carefully prepared set of design specifications will often mean the difference between a well-engineered vessel and one which is wholly inadequate for its intended service. Surprisingly enough there may be little if any cost differential between the two.

In the final analysis, a vessel will probably be only as good as the purchaser's specifications.

#### ACKNOWLEDGMENT

The author wishes to thank the Alcoa Research Laboratories for providing the photo on p. 181.

### What Some Builders Said About This Article

"We believe the examination of design conditions should also refer to the fact that the design stress decreases with increase of temperature for such materials as stainless steel and nonferrous metals. Thus, the maximum temperature limit is also important.

Perhaps you might want to include in the article the suggestion to the purchaser of having what is known as an approved list of fabricators and limiting his purchase of pressure vessels to these organizations. Several large chemical companies adhere to this policy. We would assume that they do this to insure themselves of a quality job since the fabricators on the approved list must show evidence of their qualifications." — Brighton Corp., Cincinnati, Ohio.

"We find the specifications well taken and the related information

clearly and concisely stated. We have only these comments to add:

The method of support of a vessel should be considered in the design. The support may or may not affect the design proper. If the fabricator of the vessel is to furnish the support, this should be stated clearly and any special support should be so indicated.

If the purchaser has design standards available, this information should be indicated. This applies to any class of fittings or appurtenances for which the purchaser may have a preference.

Sometimes the purchaser installs his own equipment. This should be indicated. Ladders and platforms are secondary considerations but their arrangements should be established before fabrication proceeds." — Bethlehem Steel Co., Bethlehem, Pa.



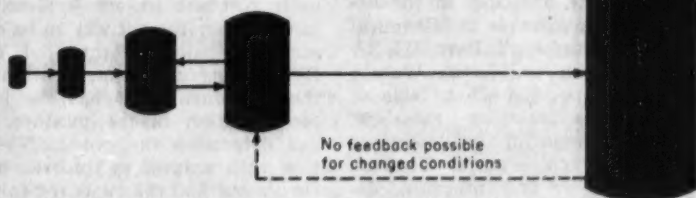
# Update Your Reactor Design Method

Chemical reactors still evolve from tedious, expensive experimentation. Instead we can, and should, use an up-to-date direct approach.

This article—second of three parts—tells how to develop reactor data.

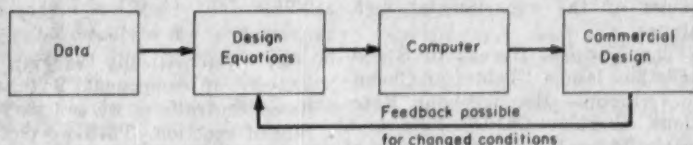
JU CHIN CHU, Rohm & Haas Co., Huntsville, Ala.\*

## Old Method



"The old practice in reactor design involves a tedious and expensive experimentation through successive stages of pilot-plant reactors to hunt for a safe risk in the final jump to production size. Collection of isolated yield information is an improper application of kinetics to reactor design. No satisfactory engineering tools can be developed."

## Today's Approach to Reactor Design



"Today, we can use an up-to-date, direct approach to the optimum design of commercial-scale chemical reactors. Develop the fundamental equations for reactor design, including a reliable kinetic rate equation. Once we establish fundamental correlations, we can operate in one direction to plan experiments; and in the other direction to predict change."

## This Issue

## The Kinetic Equation

### Last Month

How to develop the five basic reactor design equations.

### Coming

Make use of computing machines.  
What are the design limitations?

For the complete process design of a chemical reactor we need five design equations. These are: material balance, kinetic equation, energy balance, rate of heat transfer and pressure drop through the reactor. Last month we described the necessity for and the development of these equations (*Chem. Eng.*, Nov. 1956, p. 215).

This month we'll turn the spotlight on the kinetic equation. This equation can be established by a systematic study and logical interpretation of experimental data.

However, as a general rule the kinetic analysis and correlation are not undertaken until a process evaluation has established the right raw materials and the right catalyst for an economical process.

## Process Must Pay

For successful commercial operation, an economical catalyst and process must at least meet these requirements:

- Production of desired product (expressed in lb. of product/lb. of catalyst) is sufficiently high on an hourly basis. In other words, the average activity of the catalyst is high enough to warrant its installation.

- Yield (expressed as lb. moles of product/lb. mole of consumed reactant) is sufficiently high to give a manufacturing cost that is low enough to permit an attractive return on the projected investment.

- Life of the catalyst is sufficiently long and its makeup or replacement costs are low. This in turn will give relatively low cost of catalyst/lb. of product and permit an attractive return on the investment.

\* Professor Chu of the Polytechnic Institute of Brooklyn carried out the work reported in this article while acting as a summertime consultant to the Rohm & Haas Co., Huntsville, Ala.  
To meet your author, see *Chem. Eng.*, Nov. 1956, p. 410.



It's quite impossible to assign specific numbers to these three items until the necessary design data—including the kinetic equation—are obtained in the laboratory and a firm estimate of plant investment and manufacturing costs are established.

Before we have kinetic equations available, these criteria are necessarily general and qualitative. Reliable kinetic equations are the keys to specific, quantitative answers.

### How to Develop Equations

In the laboratory, the development of rate equations consists of these steps:

- Determine experimentally the rate of reaction at different temperatures, pressures and compositions of the reacting system. Include the effect of solvent and impurities. If a catalytic reaction is involved, use replicated runs to determine the activity and regeneration activity of the catalyst.

- At a fixed temperature and pressure (somewhere in the middle of the operating range), calculate the reaction rate constant for different possible mechanisms of the reaction. The mechanism that gives the best constancy of the rate constant is chosen to develop the exact form of the rate equation.

In developing the equations, the order of the reactions or the exponents for the activities in the rate equation, are determined along with the rate constant. To determine the mechanism, follow a trial-and-error procedure.

If the mechanism of a similar type of reaction is known, speculation on the mechanism of the reaction under investigation starts with analogy. It's good practice to start with the simplest possible rate expression consistent with the qualitative trend observed as reaction conditions were changed. Stoichiometry may be of assistance in formulating the simple rate equations.

All the possible mechanisms should be explored.

Integrated forms of kinetic rate equations are available in the literature. For example in "Chemical Process Principles," Part III, by O. A. Hougen and K. M. Watson we find on pp. 824-825 a table of homogeneous reaction rates at constant volume for ideal solutions at constant temperature. Then on pp. 834-836 we find integrated design equations for homogeneous reactions at constant pressure and temperature. For catalytic reactors we could use the integrated rate equations given on p. 929 of this same reference, although the use of these equations instead of simpler ones has been questioned recently.

However, the available lists of integrated rate equations still represent useful guides in correlating kinetic data within the confidence range of the experimental techniques.

The National Bureau of Standards has issued "Tables of Chemical Kinetics—Homogeneous Reactions, Circular C510." This is a critically evaluated compilation of all available (up to 1951) data on rates and rate constants of homo-

geneous chemical reactions. Data which are largely contingent on interpretations have not been included. Reactions are arranged and numbered in the order of increasing complexity of the key reactant.

In the case of organic compounds, the arrangement is in the order of increasing number of carbon atoms. Normal-chain isomers precede branched-chain isomers in the listing.

If we want to determine the order of reaction with respect to each reactant in our system we can consider the activity to be constant for all reactants but one. By varying the concentration of the component that has the least concentration in the mixture, we can determine the order of reaction with respect to this reactant. Or we can find the exponent for its activity terms in the rate equation.

Should this exponent change with temperature, catalyst concentration and other variables, we can still evaluate it quantitatively. For example, assume that the rate of a chemical reaction is represented at first by this equation:

$$R = k a_Q^2 a_P^2 a_S^2 \quad (1)$$

If a large excess of components *P* and *S* are present, their activity terms become constant and we can reduce Eq. (1) to:

$$R = k' a_Q^2 \quad (2)$$

By systematically varying the activity of component *Q* (change its concentration) we can vary the rate of reaction. Then we plot the reaction rate, *R*, vs. the activity of compound *Q* on log-log paper. The slope of the resulting curve represents the order of reaction, *q*.

We can repeat this procedure for each of the other components in the reaction, making each of them successively the least concentrated component. In this way we can determine the individual exponents in the rate equation and arrive at the complete order of reaction.

### Two More Steps

There are two more steps in developing rate equations. They are:

- Calculate the rate constant at other temperatures on the basis of the same mechanism or the same form of the rate equation.

- Tabulate the rate constants at different temperatures. Corre-

### Nomenclature (Consistent Units)

	Activity	<i>P, Q, S</i>	Reactants
<i>a</i>	See Eq. (3)	<i>R</i>	Reaction rate
<i>b</i>	Concentration	<i>R'</i>	Universal gas constant
<i>c</i>	Differential operator	$\Delta S^\ddagger$	Entropy change to form activated complex
<i>e</i>	2.7183	<i>T</i>	Absolute temperature
<i>f</i>	Fugacity coefficient of the activated complex	<i>V</i>	Volume
$\Delta H^\ddagger$	Enthalpy change to form activated complex	<i>V<sub>m</sub></i>	Average molal volume of reacting system
<i>k, k'</i>	Reaction rate constant	<i>X</i>	Conversion, moles of product formed/unit mass of feed
<i>k/h</i>	(2.0842 × 10 <sup>10</sup> )/°K—sec.	<i>Z<sub>m</sub></i>	Mean compressibility factor of the mixture in the gas phase
<i>n, p, q</i>	Number of moles of reactants involved in a chemical reaction which determines the over-all rate	$\Delta$	Finite increment of
<i>N<sub>0</sub></i>	Moles of feed/unit mass of feed	$\gamma^\ddagger$	Activity coefficient of the activated complex
<i>N<sub>10</sub></i>	Moles of reactant <i>A</i> in the unit mass of entering feed	<i>π</i>	Total pressure



late the rate constant with temperature.

For homogeneous reactions, we can check our correlation with the help of the theory of absolute reaction rate. The theory of absolute reaction rate (the Eyring theory) defines rate constant in these terms:

Gas Phase

$$k = (k/h f^\ddagger Z_M R') e^b \quad (3)$$

where  $b = (-\Delta H^\ddagger/R'T) + (\Delta S^\ddagger/R')$

Liquid Phase

$$k = (kT/h \gamma^\ddagger V_M) e^b \quad (4)$$

where  $b$  is as given above

In Eqs. (3) and (4),

$$k/h = (2.0842 \times 10^{10}) / ^\circ K \cdot \text{sec.}$$

and  $T$  = absolute temperature,  $^\circ K$ ;  $Z_M$  = mean compressibility factor of the mixture;  $R'$  is the universal gas constant;  $f^\ddagger$  is the fugacity coefficient of the activated complex;  $\gamma^\ddagger$  is the activity coefficient of the activated complex;  $V_M$  = average molal volume of the reacting system;  $\Delta S^\ddagger$  = entropy change accompanying the formation of the activated complex; and  $\Delta H^\ddagger$  is the enthalpy change accompanying the formation of the activated complex.

### Use For Guidance Only

The reaction rate constant,  $k$ , calculated by Eqs. (3) and (4) may be in error by a factor of from 10 to 100, or more. We do not suggest that Eyring's theory should be used as a basis for process design.

The engineering utility of the equation is limited to a guide for data correlation or rational extension of incomplete data for a homogeneous system.

In all the steps above, chemical equilibrium constants, activity coefficients, fugacity coefficients and compressibility factors at various temperatures are calculated by the usual methods of thermodynamics. Over-all reliability of the final rate equation can be confirmed by additional laboratory work.

This additional work will be required only at a few key points that represent the average and extreme limit of operating conditions.

### Experimental Flow Reactors

For a flow reactor, the laboratory determination of the rate of

### Integral Reactor Data Help Define the Rate

Temperature	Pressure (If Gas Phase Is Involved)	Feed Rate	Conver- sion	Compo- sition At Exit Of Reactor*	Ratio Of Reactor Volume/Feed Rate
$T_1$	$\pi$	$F_1$	$X_1$	$C_1$	$V/F_1$
$T_1$	$\pi$	$F_1'$	$X_1'$	$C_1'$	$V/F_1'$
$T_1$	$\pi$	$F_1''$	$X_1''$	$C_1''$	$V/F_1''$
$T_2$	$\pi$	$F_2$	$X_2$	$C_2$	$V/F_2$
$T_2$	$\pi$	$F_2'$	$X_2'$	$C_2'$	$V/F_2'$
$T_2$	$\pi$	$F_2''$	$X_2''$	$C_2''$	$V/F_2''$
$T_3$	$\pi$	$F_3$	$X_3$	$C_3$	$V/F_3$
$T_3$	$\pi$	$F_3'$	$X_3'$	$C_3'$	$V/F_3'$
$T_3$	$\pi$	$F_3''$	$X_3''$	$C_3''$	$V/F_3''$

\* Take a series of values for exit composition.

a chemical reaction is based upon the definition given by the following equation:

$$R = F dX/dV \quad (5)$$

If the volume of the reactor,  $\Delta V$ , is sufficiently small that the total conversion across the reactor becomes small, then we can transform Eq. (5) into:

$$R = F \Delta X / \Delta V \quad (6)$$

An experimental reaction system that can be defined by Eq. (6) is called a differential reactor.

In a differential reactor the rate of reaction is a single-value function of the composition, temperature and pressure of the system. The differential reactor offers a more direct way to measure the rate and to establish kinetic equations.

On the other hand, if the laboratory reactor is of such a size that a sizeable conversion is obtained, we call the reactor an integral reactor.

Between the integral and the differential reactor there exists a semidifferential reactor.

### Integral a Better Tool

The differential reactor is ideal from the standpoint of evaluating the rate, rate constants and the order of reaction at a single value and at a well-defined temperature, pressure and composition.

However, because of the exponential influence of temperature on the rate in most cases, it's important to have close control of temperature in a differential reactor.

Maintaining the temperature at a constant level requires a small diameter for the reactor with good provision for heat transfer through the wall of the container.

The pressure drop through an

integral reactor can be reduced to a negligible amount. On the other hand, maintenance of constant compositions in a reactor can only be done in a differential reactor where little conversion actually takes place.

Where accurate methods of analysis are available for the determination of a differential amount of conversion, we can use a differential reactor for direct evaluation of the kinetic equations without sacrificing mathematical elegance. But most industrial reactions are those that are complicated by side reactions, both simultaneous and consecutive in nature. These reactions produce compounds that are not readily reproduced in the synthetic feed to a differential reactor.

As another point of consideration, analytical procedures—be they physical or chemical—may not be quite accurate unless a substantial amount of conversion is obtained across a reactor. For a simple system that contains only a few compounds, physical measurements always provide a convenient procedure for the analysis. As the number of compounds increases as a result of complex reactions, analytical methods become time consuming and inaccurate.

Therefore the integral or semi-integral reactor is the better tool for the laboratory investigation of complex reactions.

### To Define the Rate

To determine the rate of reaction in an integral reactor, we have two methods available to us. These methods are based on the definition of reaction as given in Eq. (5).

The first method consists of an experimental determination of the



conversion,  $X$ , in terms of lb. moles of product obtained/unit mass of feed, at different rates of feed,  $F$ .

Temperature and reactor volume are held constant during each set of measurements. To obtain a uniform temperature, it's desirable to have a small diameter for the experimental reactor with ample means for heat transfer.

Data from an integral reactor can be tabulated in a fashion similar to that shown above.

When we have collected data for a table such as the one shown above, we then plot the conversion,  $X$ , vs. the ratio of reactor volume to feed rate (or the reciprocal of space velocity) at various temperatures.

We've constructed a sample plot and it is shown below.

According to the modified form of Eq. (5),

$$R = dx/d(V/F) \quad (7)$$

The slope of the curve is equal to the net rate of reaction. Since most kinetic data are erratic, the

best curve should be drawn first by a statistical method. Then the slope can be measured graphically or it can be calculated by differentiation after we fit an appropriate equation to the curve.

It's desirable to conduct an error analysis to determine the range of confidence of the net rate data. The range of confidence will reflect the accuracy of our primary measurement and control, such as the method of analysis, control of temperature fluctuation in the experimental reactor, etc.

Another way to determine the net rate of reaction in an integral reactor is to vary conversion by varying the volume rather than the length of the reactor.

This method is an inconvenient procedure for an integral reactor. On the other hand, it can be done more conveniently in a semi-integral reactor that has sampling ports located along the reactor. One caution to be observed in using such a technique is that the amount of sample should be neg-

ligibly small when compared to total flow. Otherwise the mathematical continuity of Eq. (7) may not be the actual condition in the physical model.

For obtaining most industrial data, it's convenient to have such a reactor in tube form ranging from 6 to 10 ft. in length.

We must emphasize that this type of experimental reactor, integral or semi-integral, can only be used to obtain kinetic data on reactions that exhibit a normal dependence of rate on temperature, partial pressures and compositions.

In such cases, the temperature variation from the inlet to the exit of a reactor follows a smooth curve and does not develop a sharp temperature rise at any local point within the tube. Notable exceptions are some oxidation reactions.

The occurrence of a sharp temperature rise does not permit the development of any fundamental kinetic analysis. Conversion can only be correlated empirically as a function of hot-spot temperature, throughput, etc.

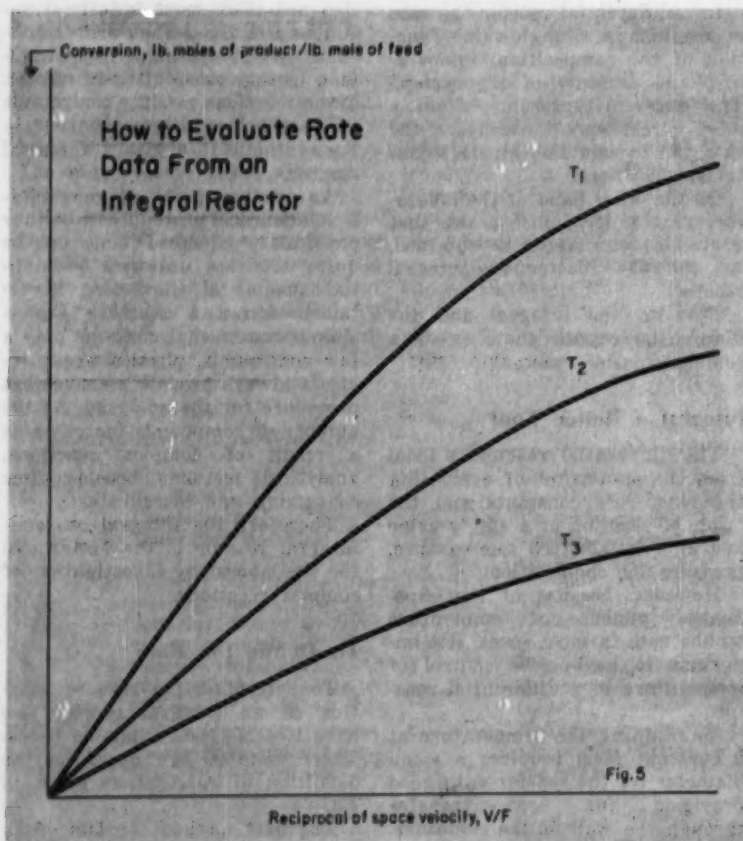
For reactions of simple order, we can develop constants including the rate coefficient through the use of an integrated expression.

For example, the integrated equation for a first order and homogeneous reaction at constant temperature and pressure is given by:

$$V/F = (1/k) (N_o/\pi) \left[ (-2X_A/N_o) + \left( 1 + \frac{2N_{Ao}}{N_o} \right) \ln \frac{N_{Ao}}{N_{Ao} - X_A} \right] \quad (8)$$

The equation is derived for a flow reactor in which only a single first-order reaction yields 2 lb. moles of product/lb. mole of the converted reactant. There is only one rate coefficient to be determined if the over-all net rate of conversion in the reactor is determined by the chemical reaction.

We can plot the terms within the bracket on the right-hand side of Eq. (8) vs. the ratio of reactor volume/feed rate. Pass a best-straight line through all the points, and the slope of this line is the rate coefficient. However, this procedure is limited to reactions of simple and well-defined orders. It is not applicable to most reactions that occur in industrial reactors.





For Towers . . .

Tanks

Pumps

Compressors

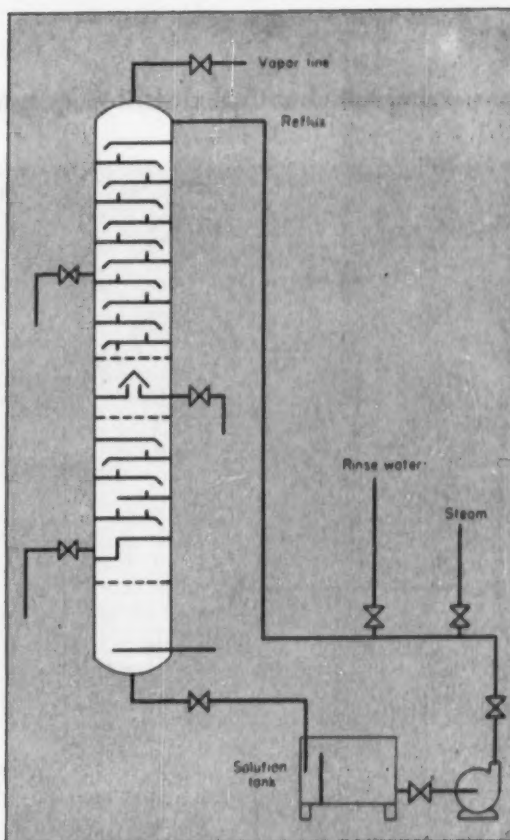
Exchangers

Condensers

Lines

Fittings

Valves



## How to Clean Equipment Chemically

There's more to chemical cleaning procedures these days than suds in your eye. Specialists in the field use new combinations of cleaning chemicals to keep the equipment on stream.

**R. L. FISKE, Oakite Products, Inc., New York, N. Y.\***

In the manufacture of chemicals such as acetylene, polyethylene, carbon tetrachloride, glycols, synthetic resins and thousands of other compounds, equipment must be kept free of deposits. Otherwise, heat transfer is retarded, flow is impeded and the product may become contaminated.

Many of the deposits that form in chemical process equipment prove so stubborn that equipment is dismantled and cleaned by scraping, rodding out, sand-blasting or other mechanical means. But more and more these

days this last ditch, time-and-labor-consuming method is avoided by chemical cleaning.

Techniques for cleaning chemically were developed chiefly in the petroleum refining industry. During the twenties, refineries first adopted chemical methods to clean pipes and fittings, strip paint from oil storage tanks, clean tank interiors, and descale heat exchangers and condensers.

Gradually, as knowledge increased, small towers were cleaned. Today, the largest towers that process stocks of all kinds are cleaned chemically in routine fashion. Equipment, ma-

terials and methods developed for refineries are proving very successful for cleaning chemical process equipment.

### What Is Specialized Cleaner?

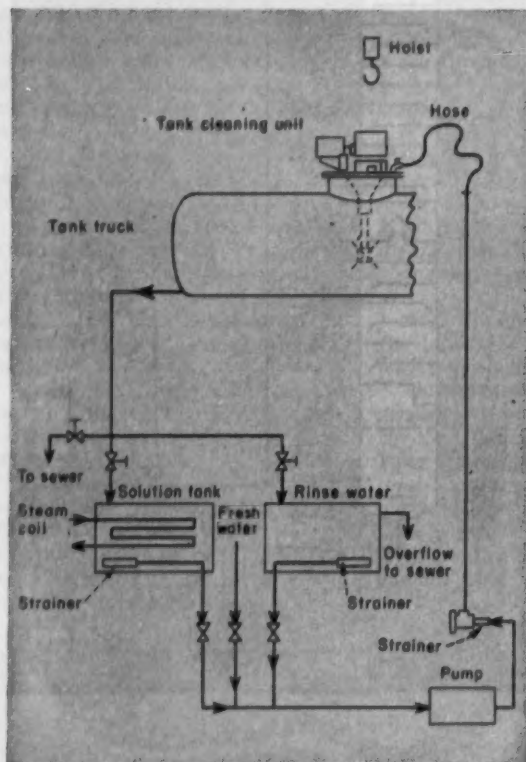
Prepared cleaning materials first appeared early in this century. The early types were simple compounds containing caustic, soda ash, fatty acid soaps and similar ingredients.

In the late twenties rosin soaps were incorporated. Later, tall oil soaps were introduced. Still later, sequestrants, chelating agents, dispersing agents and

\* Meet your author on page 406.



## How permanent chemical cleaning equipment is set up today in big eastern chemical



### SETUP

other broad classifications of ingredients became available.

Today, the research specialist on chemical cleaning has available literally thousands of raw materials from which to select components for specialized cleaning compounds. Also, many ingredients are available for the preparation of solvent and acidic type cleaners. Much research has been done and continues with such combinations as non-ionic and anionic surface active agents; synthetic detergents plus soap; mixtures of water-soluble solvents; surface active agents and acids.

We might say a word about using materials synergistically. To refresh your memory, synergism is cooperative action of individual chemicals such that the total effect is greater than the sum of the two effects taken independently. With many of the cleaning compounds available to-

day, better results are obtained than would be possible through use of the individual components in the compound.

### Which Specialized Cleaner?

Now that we have defined the meaning of specialized cleaning compounds, you undoubtedly wish to know which specific cleaner to use on a given deposit or soil. Because our experience shows that each cleaning job presents individual problems, we feel only broad classifications can be given.

For example, properly inhibited hydrochloric acid materials usually dissolve most types of hard water scale. Heavy duty alkaline materials generally can be relied upon to remove ordinary grease and oil deposits.

But in the chemical process industries these types of deposits and soils are not the problem. In

chemical processing we are dealing with complex compounds whose exact nature often is not known.

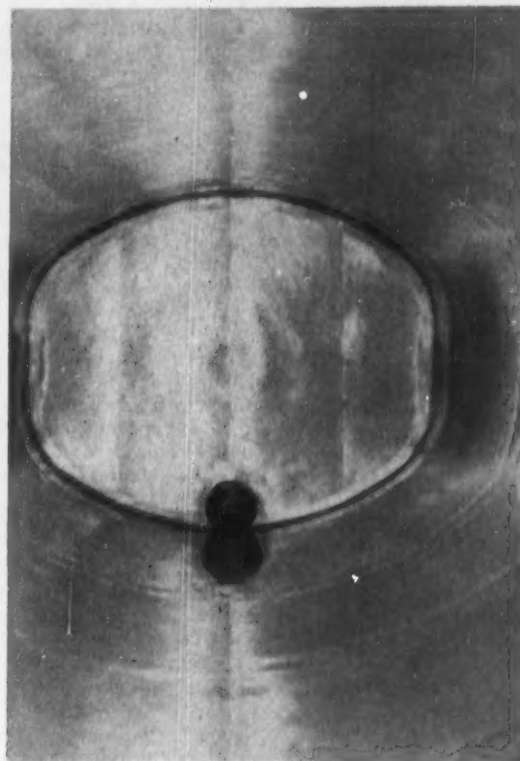
Cleaning specialists have a saying that no two jobs are alike. Thus, you might find that the materials and methods used successfully to clean a glycol tower in one part of the country are not necessarily successful in cleaning a glycol tower in another area. This could be caused by variations in equipment design, the stock processed, temperatures and other process conditions. Therefore, choice of cleaning materials must, of necessity, be worked out empirically.

You'll see what we mean from the history of a couple of typical cleaning jobs on chemical process equipment.

A 5 by 35 ft. gas separation tower packed with 21 ft. of Raschig rings had become



plant to clean soils from interiors of tankers that link supplier with consumers.



## PROCEDURE

plugged to the inoperative point by a heavy, gum-like, brown deposit. The plant laboratory tried six different specialized cleaning compounds which had been used successfully on other jobs—three alkaline products, one acidic and two solvent-detergents. None had any effect.

The technical service representative from a manufacturer of specialized cleaning compounds was called in. He tried five different products, separately and in combination. One of them, a newly developed acidic solvent, started to break down the deposits after 30 min.

A 4-hr. test with a 20% solution of this material at 170 F. showed that it could break down the deposits completely. A further check revealed that it would not attack the stainless-steel towers within the period of time needed to dissolve the deposit.

All 15 of the gas separation towers at this plant are now cleaned with this material.

An ethylene scrubber tower cleaned recently at a mid-west chemical plant is 55 ft. high and 5 ft. in diameter. Tower is lined with plastic and is packed with 40 ft. of 1½ in. Raschig rings.

Prior to cleaning, the tower had been in service for three years and was contaminated with iron oxide and oil deposits. Twenty percent by volume of an acidic cleaner, formulated to remove carbon deposits, was circulated at 125 F. for 15 hr. at 285 gpm. A 6-hr. rinse completed the cleaning.

### Clean by Circulation

Much can be gained by cleaning with the circulation method. It decreases substantially both the cost of cleaning and tower off-stream time. It eliminates

## RESULT

time-consuming operations such as steaming and gas-freeing the tower; manual cleaning of trays, grids and bubble caps.

If a tower is to be cleaned by the circulation method, a drawing of the unit should be checked to determine the internal construction. Then, the tower should be checked to determine its condition.

Lines into the tower should be inspected. If other work is to be done, blinds should be installed where needed. Arrangements should be made to vent the gas that might form during cleaning.

Capacity of the solution tank should be sufficient to fill all trays and the base of the tower, while maintaining circulation at the desired rate. The return line should have twice the capacity of the pressure lines.

If a highly acidic product is chosen for the job, an acid-resistant pump should be used. In



most cases however, acidic cleaners are inhibited so that the product pump can be used safely for circulation at the temperature and time required. This also applies to gaskets, packings and other surfaces which the cleaning solution contacts.

### When is Job Complete?

How do you know when the tower is clean? There are several yardsticks. Titration is one.

At the start of the job the concentration is checked to be sure that the desired level has been reached. As circulation progresses, periodic titrations are made. If the solution is working effectively, strength will drop steadily.

When the reading remains constant it means one of two things. Either the tower is clean or the solution strength is depleted. Visual inspection of the top trays through the handholes provides the answer. If deposits still remain, the solution tank is recharged and circulation resumed.

In chemical cleaning, as in cooking, you acquire a knack, feel or instinct which tells you when the job is done. From experience, the cleaning engineer knows how strong to mix the solution and how long to circulate. He knows when intermittent circulation is more effective, that on some towers an occasional blast of steam or air helps to jar loose tenacious deposits, that a pre-rinse often is advisable, that pre-cleaning with solvent or mixing the solvent with alkaline or acidic material is sometimes the best answer.

Plant personnel learn from the technical service representative. They soon acquire the know-how and experience which comes from actually doing the job themselves.

### Widely Used for Parts

A good way to evaluate the possibilities of modern detergent materials is to try them on a simple job such as compressor valves. Most chemical processing plants have many of these valves and in many cases they are difficult to clean. Heavy carbonaceous deposits build up in

the small openings of these valves, impeding their operation and even discoloring the product.

Valves can be restored to good condition by boiling for four hours in a solvent type heavy duty alkaline detergent, followed by a high-pressure steam rinse. This is much faster than the sandblasting method used formerly and makes possible a regular valve-cleaning schedule. Valves are pulled and replaced with spares as soon as they begin to get fouled up.

Compressor valves usually are cleaned at a centrally located point nearest to the compressor installations. Or perhaps cleaning is part of the salvage shop operations.

Many chemical process plants have established a salvage shop where valves, pipes and fittings are overhauled. A must in such a shop is a tank of cleaner formulated specifically to strip grease, paint, rust and other corrosion products from the parts and restore them to a clean condition.

To the salvage shop are brought also heat exchanger bundles which cannot be cleaned by circulation. They are boiled in a tank or trough charged with suitable cleaning compound. Solution-lifting steam guns also are brought into play on difficult jobs such as this.

Where equipment becomes completely plugged or is loaded with deposits which defy all known chemical detergents and combinations thereof, it must be cleaned mechanically by rodding out, sandblasting and hand scraping. Or it must be scrapped.

A program of preventive maintenance—chemical cleaning at regular scheduled intervals—can often preclude such expensive alternatives.

### How to Clean Rolling Stock

For cleaning interiors of tank cars and tank trucks, mechanized cleaning holds the spotlight. Such methods permit a tank to be cleaned in as little as two hours.

One device of this type mounts in the manhole and delivers hot detergent solution through two nozzles which revolve in concentric circles. The knife-like cutting action of the 100-175 psi.

solution removes the most adhesive, dried-on deposits from every square inch of the interior.

A return line brings the solution from the tank car back to the solution tank where it is reheated and recirculated until cleaning is complete.

The same unit is used for hot water rinsing. A wide selection of specialized detergents is available to remove practically any type of deposit.

In baffled tank trucks each compartment must be cleaned individually. One unit for this job consists of a small rotary head mounted on a tripod. The head is fitted with six, wide-angle, flat-spray nozzles which are placed so that the sprayed streams of cleaning solution overlap and cover all surfaces.

One of these units is placed in each compartment and connected by a manifold to a pump that draws solution from a single tank. Solution is pumped at the rate of 25 gpm. at 60 psi. and recirculated. With this procedure, tank cars can be cleaned within 2 hr. total time.

The rotary sprayer head also can be mounted on a pipe and inserted into the top of each compartment, where a 6-in. opening is available or installed.

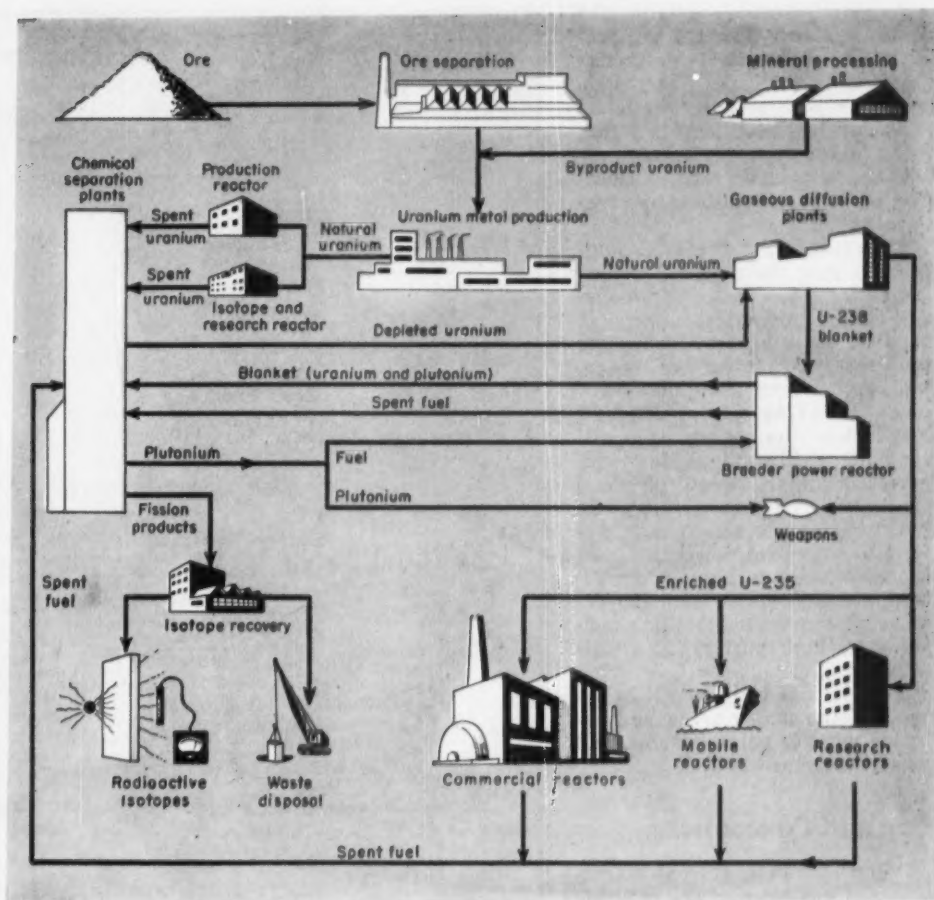
Many cars require no cleaning at all or can be renovated simply by boiling them out, when required. An example of the latter is the problem encountered by a manufacturer of carbon tetrachloride.

Occasionally, an entire tank car was rejected because the material was off-color. As a result, the carbon tetrachloride had to be redistilled.

The trouble was found to be brownish scale knobs like barnacles which adhered to the tank wall and apparently discolored the lading. The knobs were removed by boiling out the car with a heavy duty alkaline detergent.

Enough water is run into the car to cover the steam coils and a drum of detergent is added. The steam is turned on. When the solution reaches a boil, the resultant agitation contacts the solution with the deposits to dissolve them. After an 8-hr. boil, the job is finished with a hose rinse.





THE COMING

## Nuclear Industry

Who-is-doing-what in the growing commercial nuclear industry of significance to chemical engineers and the CPI.

**H. E. ANDERSON, Engineering Consultant, Burbank, Calif.\***

**W**ITH the birth of a new industry, there are many new and difficult problems connected with its satisfactory development. So it is with the rapidly forming non-military commercial nuclear industry (see map next page).

This article is a progress report on the industry: a who-is-doing-what in the U. S., of significance to chemical engineers and the chemical process industries.

\* Meet your author on page 407

We are primarily concerned here with peaceful aspects of atomics. This word "peaceful" places a severe design restriction on processes and equipment—the restriction of economics. An engineer now must produce a design that not only does a job, but does it economically.

Problems facing the a-borning industry are mainly engineering problems—many calling for the skills and background of chemical engineers.



The establishment of a nuclear power industry involves the production of many materials: uranium, thorium, beryllium, zirconium. Operation of many chemical processes is called for: metal purification by solvent extraction, separation and purification of intensely radioactive materials.

Where does the chemical engineer fit into the picture? Along the entire line—from the production of ore concentrates, through metals manufacture (chemical processes), power reactor design, fuel reprocessing, to application of reactors and nuclear radiation.

A look at the activity map will show it is liberally dotted with names familiar to all chemical engineers. The industry is now in the development stage—new materials of construction, new processes, new techniques are all being worked on to meet the demanding requirements (high temperature, high purity) of atomic energy.

Now let's place a spotlight on each of the major areas and examine what is going on now, and what the future holds.

## Ore and Concentrate

**Ion exchange, solvent extraction are some of the methods used for boosting yields.**

The reactor raw material, uranium, has become well known to the public in the past three years through extensive publicity.

Many individuals have become wealthy overnight as a result of uranium discoveries. The production and concentration of ore is the first step in the atomic power cycle.

In concentrating, mined ore (0.1-0.5%  $U_3O_8$ ) is leached with either sulfuric acid or sodium carbonate solution, leach liquors are separated from insoluble sands and slimes and uranium recovered (75%  $U_3O_8$ ) from the liquor.

Much chemical engineering work has centered on obtaining maximum yields from the leach liquors, including solvent extraction, column ion exchange and slurry ion exchange. All three techniques are used on the Colorado Plateau—our main U. S. source for uranium.

It is not possible to accurately measure the dollar value of all the



uranium prospecting, exploration and developing activities, but when added to production and construction expenditures we have at least a \$100 million business.

There are about 12 large mills operating in this country (more than 20 throughout the world) producing uranium oxide, with additional plants in various phases of design and construction. Upon completion of projects underway.

or definitely planned, production in the free world should be in excess of 80,000 tons/yr. of  $U_3O_8$ .

Presently the U. S. is the largest producer of uranium, Canada is next, then the Belgian Congo.

### Byproduct Uranium

To the swelling production of  $U_3O_8$  from primary ore you can add the significant amounts of





uranium that come from the production of phosphoric acid and phosphate fertilizers. Solvent extraction using a decyl ester of pyrophosphoric acid is used to recover the uranium in phosphate rock. Three companies in Florida are now active in this recovery program (see table). The concentration of uranium here is around 100 parts per million. Related to this is the large recovery operations

for uranium from South African gold operations—particularly from mill tailings. About \$180 million is now invested in uranium recovery plants in South Africa.

A number of processes are competing in the recovery of uranium from phosphates and from low grade ore. Solvent extraction and ion exchange are dominant now, but much development work is in progress.

## Planning

Major requirements for uranium ore are principally of a military nature today and our production capacity will be geared to meet the defense demand for an indefinite period. However, the present supply appears sufficient to materially assist the program for peaceful uses of atomic energy. A recent survey by the Atomic Industrial



## Major Producers of Uranium Ore

### U. S. Mining

**Anaconda Copper Mining Co.** produces uranium from largest mine in U. S. Operates a processing plant for ore.

**Atchison Topeka and Santa Fe Railway Co.** produces uranium from mines through Haystack Mountain Development Co., a subsidiary.

**Beaver Lodge Oil Corp.** holds a major interest in Rocky Mountain Uranium Corp., which has uranium properties in the Circle Cliffs Area (150 claims) and the Temple Mountain Area of Utah.

**Climax Molybdenum Co.** owns 84% of Climax Uranium Co. and holds dominant interests in two thorium exploration companies in Colorado.

**Climax Uranium Co.** produces uranium from a number of mines in Colorado in the vicinity of Grand Junction. Operates a processing plant for ore.

**El Paso Natural Gas Co.** has a subsidiary, Rare Metals Corp., which is prospecting for uranium in Utah, Colorado, Nevada, Wyoming and New Mexico. Rare Metals Corp. has an AEC contract for construction and operation of a uranium processing plant at Tuba City, Arizona.

**Food Machinery and Chemical Co.** has made arrangements through a subsidiary to prospect for uranium on 10,000 acres of land owned by Atchison, Topeka & Santa Fe Railway.

**Four Corners Uranium Co.** (now Vitro) produces uranium from mines at Green River, Utah; Lion Creek, and Morrison, Colorado; is drilling and prospecting for uranium in Colorado, Utah and Wyoming. Vitro has a mill at Salt Lake City.

**Uranium Reduction (et al)** produces uranium from properties near Moab, Utah, has potential holdings in Colorado and Wyoming; spent over \$1 million in development work.

**Kerr-McGee Oil Industries** is prospecting in Wyoming, producing uranium in northeast Arizona and operating a uranium processing plant at Shiprock, N. M.

**Minerals Engineering Co.** is engaged in contract drilling for uranium prospectors and miners. Owns 25% of the Burwell Process for uranium extraction.

**Penn Texas Corp.** produces uranium through a subsidiary, Penn Uranium Corp., at mines near Flagstaff, Arizona.

**Sabre Pinon** is building an ore processing plant at Ambrosia Lake, N. M.

**Vanadium Corp. of America** is producing uranium from approximately 40 properties in Colorado.

**Texas Zinc Minerals Co.** (Texas Co. and N. J. Zinc) plans to build a uranium processing mill to exploit the Happy Jack mine in Utah.

**Dawn Mining Co.** is building a 400 ton/day, \$3 million uranium ore processing plant at Ford, Wash., for July 1957 start-up. Catalytic Construction is designing a unit for producing uranium metal via uranium oxide for Dawn.

**Union Carbide Nuclear Corp.** has a large number of uranium mines throughout the Colorado Plateau, and large ore-refining mills at Rifle and Uravan, Colo. Union Carbide manages Oak Ridge and Paducah for the AEC.

### Canadian Mining

**Can-Met, Northspan Uranium, Consolidated Denison, Milliken Lake, Stan-can Uranium, Algom Uranium, Stanleigh Uranium** are developing uranium properties in Blind River, Ontario.

**Gunnar Mines, Ltd.** is producing concentrates under a \$77 million contract with the Canadian Government. Developing claims with large proven uranium reserves in the Beaver Lodge area of Lake Athabasca, Saskatchewan.

**Lorado Uranium Mines, Ltd.** is also developing substantial claims in the Beaver Lodge area of northern Saskatchewan.

**Pronto Uranium Mines, Ltd.** is producing concentrates under a \$55 million contract with the Canadian government and developing substantial ore reserves in the Blind River areas of Ontario.

**Strategic Materials Corp.** is developing through its subsidiaries, Blue Rock Cerium Mines and Halo Uranium Mines, uranium and thorium properties in the Bancroft area of eastern Ontario.

### U. S. Byproduct Uranium

**International Minerals & Chemical Corp.** produces uranium as a byproduct of triple superphosphate production at a plant at Bartow, Florida.

**Minerals & Chemicals Corporation of America** assisted in developing the process for byproduct uranium from phosphate rock. Operates plants at Philadelphia, Pa. and Lakeland, Florida. Also Virginia-Carolina at Nichols, Fla., and U. S. Phosphoric Products are active in this field.

Forum estimates an 8,000 ton non-military requirement per year within the next decade.

## Producing Fuel

**Uranium and thorium are important reactor fuels produced via chemical processes.**

Until recently practically all phases of nuclear fuel production were under government control and conducted in government-owned facilities. Participation in these activities by private industry was limited to mining and milling.

Although much experience has been gained by private industry in the operation of AEC facilities through government contracts, the initiative and incentive for private research and development in this field has been hindered somewhat by government restrictions. This situation is rapidly changing.

### Producing Uranium Fuels

Before the atomic age, uranium concentrates, as described previously, were pure enough for many commercial applications (coloring glass and enamels).

However, before uranium can be used in a nuclear reactor it's necessary to reduce the content of neutron absorbing impurities to concentrations in parts per million.

There are now two large plants in operation in this country for the purification of uranium concentrates, and the manufacture of uranium metal. Both are AEC plants; one at Fernald, Ohio, operated by National Lead, the other at St. Louis, operated by Mallinckrodt. Another is under construction at the Weldon Springs ordnance works, 25 miles from St. Louis—engineered by Blaw-Knox.

Usually uranium oxide or other concentrates are dissolved in nitric acid and sent to an extraction column. Here the aqueous solution of uranyl nitrate is extracted countercurrently with a solution of tributyl phosphate in kerosene. Uranium is stripped from this solvent with water, concentrated and calcined to  $UO_2$ . This feeds into a series of furnaces where it is reduced to  $UO$ , with hydrogen, then goes to  $UF_4$  with  $HF$ . The  $UF_4$  (green salt) is reduced to metal via reduction with magnesium. The rough "biscuit" is melted under



vacuum; cast and rolled, extruded or forged for reactor elements (see flowsheet).

The process is basically chemical. Without a doubt chemical engineers will play a big part in the design and construction of any commercial plants for the production of uranium metal.

Just recently the AEC announced that seven proposals have been received from industrial firms for production of refined uranium salts in privately owned and operated facilities.

Proposals were received from: Union Carbide Nuclear Co.; Koppers Co. and Kennecott; Dow Chemical; Twentieth Century Materials Corp; Climax Molybdenum Co. and Mallinckrodt; General Chemical; Vitro Corp. of America.

The original program asked for proposals from qualified firms to process uranium ores or concentrates to yield uranium trioxide, uranium tetrafluoride or uranium hexafluoride at the rate of 5,000 tons of equivalent  $U_3O_8$  per year.

### Producing Thorium Metal

Thorium has not been used extensively up until now in nuclear reactors. As nuclear power becomes more important, however, it seems probable that the thorium-U-233, fuel cycle\* will be used as much as the U-238-plutonium cycle. Thorium will find its greatest application in breeder reactors. It is much easier to reprocess than uranium.

Monazite, a phosphate of mixed rare earths, is the only important source of thorium. It is first concentrated by specific gravity and magnetic methods. Because of the difficulty of separating thorium from monazite considerable secrecy surrounds the various processes developed.

However the Ames Laboratory of the AEC in Iowa has disclosed information on a process based on sulfuric acid digestion.

A solution of thorium, rare earths, uranium sulfates and  $H_2PO_4$  is filtered, then partially neutralized with ammonium hydroxide. This precipitates nearly all the thorium and about 5% of the rare earths. This is extracted with solvent (tributyl phosphate) and

\* When contacted by a neutron Th-232 forms unstable Th-233, which in turn forms U-233.

metal produced using a process similar to that for uranium.

### Reactor Materials

Zirconium is the metal generally preferred for use in the core of power-producing, water-cooled reactors, or as cladding material. It absorbs very few neutrons, but has excellent corrosion resistance. Hafnium, which comes from the same zircon ore and must be separated from zirconium, has a high affinity for neutrons, has good corrosion resistance and is valuable in control elements for water-cooled reactors. Beryllium is another important metal for nuclear reactors because it has high neutron absorption and hence can be used for control rods.

All these metals require chemical processing: from ore treatment to metal purification.

### Reprocessing Spent Fuel

Reprocessing of spent reactor fuel calls for complicated chemical processing.

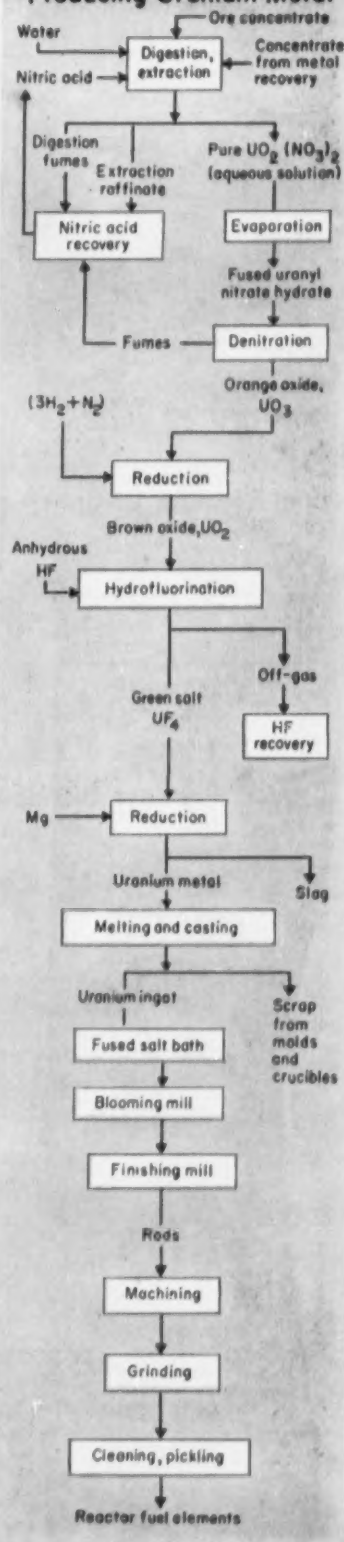
Under ideal conditions a nuclear reactor would be charged with a fixed amount of nuclear fuel (uranium) which would remain until all of it had been converted into heat or electrical energy and fission products. This would minimize chemical reprocessing, fuel element preparation and fission product separation for isotopes.

Unfortunately, it is necessary to remove the fuel after a certain length of time. The production of neutron-absorbing fission products, as well as difficulties encountered from corrosion and radiation damage to structural materials and/or fuel elements, make extended operation impossible.

Uranium-235, the isotope of uranium in which fission occurs most readily, is present to the extent of only one part to 140 parts of U-238. Uranium-238 is converted to plutonium by absorbing neutrons. Thus our fuel when removed from the reactor contains approximately 90% or more of the fissionable material, and must be chemically processed to separate out the fission products and allow reworking of the uranium into usable fuel elements.

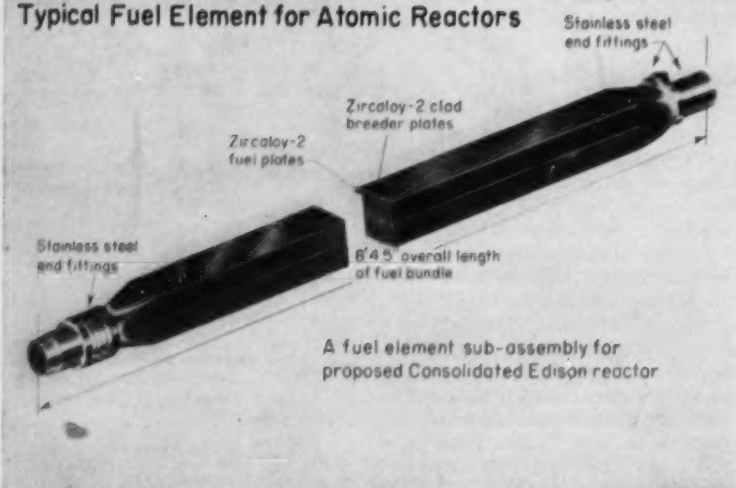
The basic chemistry of reprocessing partially spent solid fuel

### Producing Uranium Metal

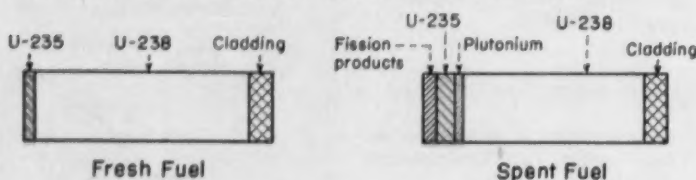




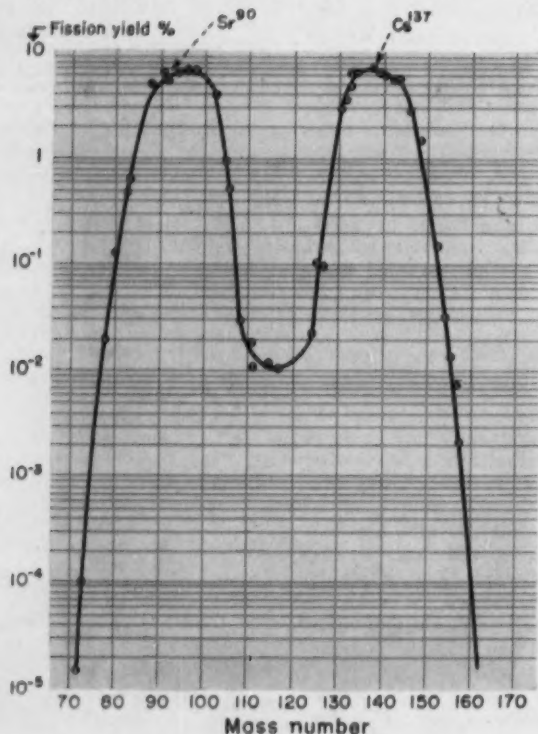
# Typical Fuel Element for Atomic Reactors



## Fuel Element Composition: Before and After



## Fission Product Distribution



consists of three essential steps: solution, extraction and separation (see flowsheet).

The problem of chemical processing of fuel is inherently tied closely to reactor development; when the reactor is planned the fuel processing method is chosen, and the overall costs will rise or fall depending upon the method.

## Solid and Liquid

Our present concentration on a reactor development program, with its wide variety of fuel elements and configuration, tends toward neglect of fuel processing. This has presented an economic deterrent to private industry, quite apart from the engineering and design problems encountered.

The advanced state of development of solid fuels as opposed to liquid fuels assures their use for some time to come. To date practically all nuclear reactors have used the solid form of fuel. However, the difference between the two forms of fuel profoundly affects both the nature and the cost of the entire reactor system.

Due to insufficient data, comparative economic studies covering the two different fuel systems are impossible. A comparison of the characteristics of each fuel shows that costs of solid fuel and fuel reprocessing are high, ultimately affecting the cost of power. Although liquid fuels are potentially attractive, their use is limited by corrosion and problems of mass transfer involving vessels, piping, valves and related equipment.

Since a large percentage of nuclear fuel remains available after the first operation cycle, several cycles of "burn-up" and reprocessing are necessary for maximum fuel utilization.

In brief, the sequence of steps in chemical reprocessing of solid fuel elements goes something like this: decanning or removing the solid fuel-element jacket by dissolving, followed by dissolving the fuel; separation of chemical elements; then purification and reconversion to solid metallic form for fabrication into new fuel elements. This basic process is tremendously complicated by the intense radioactivity of the materials in process. Materials must be handled remotely behind concrete walls. To be economical a chemical process for fuel



recovery must achieve high yield of maximum purity in minimum time at low cost.

At the United Nations' International Conference on Peaceful Uses of Atomic Energy, Dr. Stephen Lawroski, director of the chemical engineering division of Argonne National Laboratory, described four other outstanding methods of chemical separation not including solvent extraction. They were: (1) precipitation, (2) ion exchange, (3) fractional distillation, and (4) pyrometallurgical techniques. Many other methods are under investigation and study, aiming at development of the method most suitable for reprocessing and fuel recovery.

The foregoing brief description of reprocessing problems points up the tremendous task to be undertaken in successfully developing one or more methods for the recovery and purification of nuclear fuels. This is necessary if we are to produce electric power from nuclear energy on a basis competitive with other fuels.

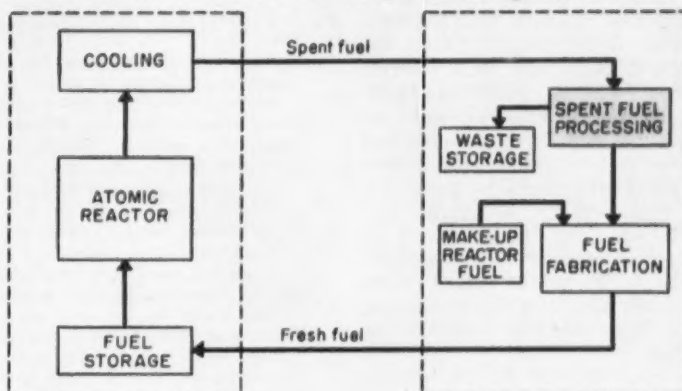
### Progress in Planning

How are we to get low unit fuel costs and thus low-cost nuclear power? The answer to this lies in great part in high-volume nuclear fuel processing and fuel fabrication.

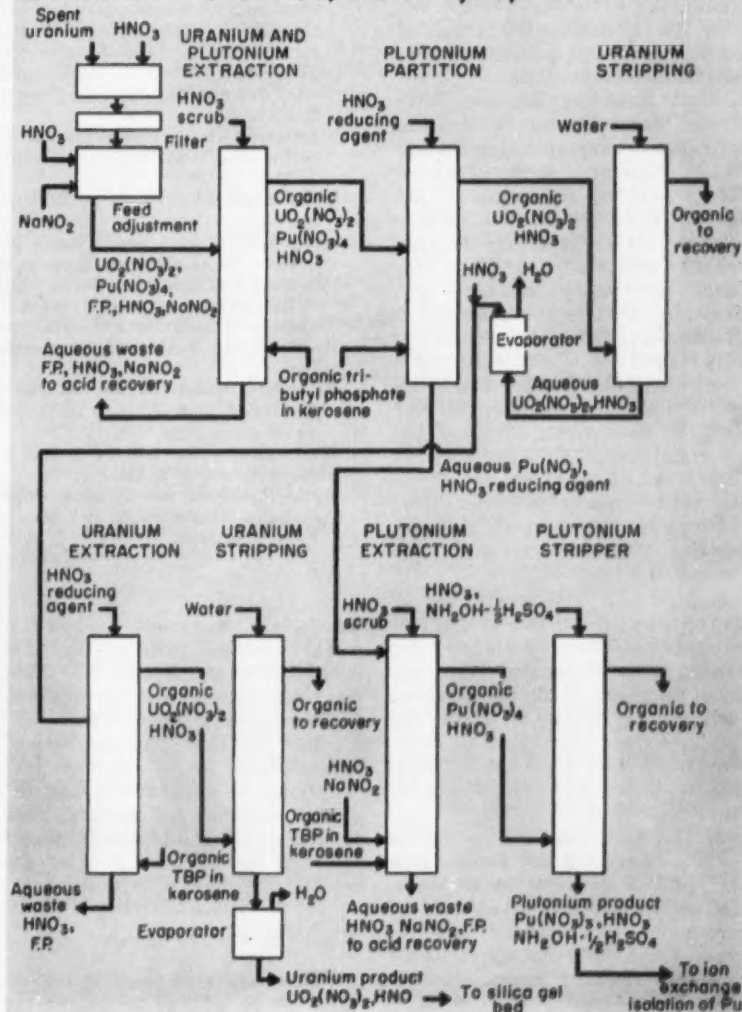
To achieve this ultimate goal the AEC announced on January 5, 1956, its approval of a program to encourage private industry to build and operate plants for the processing of fuel elements from research and power-type reactors. Prior to the signing of the Atomic Energy Act in August 1954, the majority of plants and facilities were not only government owned, but controlled and managed by the AEC. When the AEC made its program known last January at Idaho Falls, the main points as covered by J. Kenneth Davis, Director of the Division of Reactor Development, included:

1. All available AEC technology on chemical processing will be made available to industry, through appropriate means such as reports, seminars, and plant visits in accordance with regulations governing the access permit program (Chapter 10, Part 25, Code of Federal Regulations).
2. A description of the types and amounts of miscellaneous irra-

### Reactor Creates Need for Reprocessing Spent Fuel



### Extraction Process Separates U, Pu, Fission Products





diated fuels expected to be available in the foreseeable future from certain AEC reactors, from military reactors, from privately owned research reactors and from foreign sources, will be made available.

3. The metal recovery plant at Oak Ridge and the Idaho chemical processing plant were built primarily for developmental purposes and for the recovery of major and special nuclear materials from government reactor fuels. The AEC would prefer not to employ them as service facilities for processing fuels from the atomic power industry.

4. The AEC will consider making available to industry (for set periods of time) spent fuel.

Included in such fuels would be materials from the following reactor programs: Reactor Development Division—Materials Testing Reactor, Experimental Breeder Reactor No. 1, Submarine Advanced Reactor, Large Ship Reactor, Submarine Intermediate Reactor Mark A, Bulk Shielding Reactor, Pressurized Water Reactor, Sodium Reactor No. 2, Experimental Boiling Water Reactor, Army Package Power Reactor, Engineering Test Reactor, Homogeneous Reactor Experiment No. 2; Production Division—X-10 reactor at Oak Ridge National Laboratory; Biology and Medicine Division—reactor at Brookhaven National Laboratory; Department of Defense—Submarine Thermal Reactor Mark II, Submarine Intermediate Reactor Mark B, Submarine Advanced Reactor and Large Ship Reactor, the fuels of which AEC had previously planned to process in its facilities; university, institutional and industrial research reactors; and foreign reactors.

5. The AEC will permit use of its facilities (to the extent they can be made available) by industry for development work and other related purposes, with full cost of such use to be recovered by the AEC. (Patent provisions to cover the use of such AEC-owned facilities would be incorporated in such an arrangement.)

6. The AEC will invite proposals from industry for the design, construction, and operation of chemical processing plants, capable of processing one or more of the fuel types which will be employed in projected licensed power reactors, plus limited quantities of AEC

## Major Companies in Reactor Materials

### Fuel Fabrication and Chemical Processing

**Sylvania Electric Products, Inc.**, with almost 10 years experience in the fuel business, embarks on an extended program (5 to 10 years) to establish a complete out-of-pile fuel service.

**Allis-Chalmers Mfg. Co.**, Milwaukee, Wis., has a diversified atomic program underway, including manufacture of reactors and reactor components.

**Vitro Rare Metals Co.**, Canonsburg, Pa., operates a scrap recovery plant for secondary recovery of uranium from scrap metal and scrap material. The uranium and fluoride compounds are contained in process scrap from government owned production plants operated for the AEC by private contractors. Also plans to put a \$1-million commercial primary uranium processing plant into production in 1957.

**Battelle Memorial Institute** operates ore treatment and chemical engineering laboratories for the recovery of fissionable materials.

**Metals and Controls Corp.** operates a fuel element fabrication plant at Attleboro, Mass., under AEC contract and will fabricate the MTR type 90% enriched fuel elements for Battelle's swimming pool type research reactor.

**National Lead Co.** operates a government plant at Fernald, Ohio, under contract to the AEC, producing uranium metal by thermite reduction of uranium tetrafluoride with magnesium. National Lead intends to build a commercial plant to reprocess fuel. It also operates AEC's uranium ore processing mill at Monticello, Utah, and feed materials plant at Winchester, Mass.; also a raw materials development laboratory.

**Mallinckrodt Chemical Co.** produces uranium metal by thermite reduction of uranium tetrafluoride with magnesium in a government plant at St. Louis, Mo., under AEC contract. Will operate Weldon Springs plant, and has just started up a private uranium oxide plant near Hematite, Mo.

**Babcock and Wilcox Co.**, Lynchburg, Va. has the first lump-sum AEC contract for the fabrication of reactor fuel elements in a privately owned facility.

**American Lithium Chemicals Co.** produces lithium and lithium salts at a \$6.6 million plant at San Antonio, Texas. Part of the production goes to AEC.

**Foote Mineral Co.** produces lithium and lithium salts at Sunbright, Va., for the AEC.

**Lithium Corp. of America** has a plant at Bessemer City, N. C., producing lithium chemicals; part goes to the AEC.

**Combustion Engineering Corp.**, which constructs heavy nuclear reactor parts at its Chattanooga plant, makes fuel elements at Windsor, Conn., where a nuclear engineering and development center is under construction.

**Walter Kidde Nuclear Corp.** operates nuclear laboratories at Garden City, L. I.

**Catalytic Construction Co.** has contracted with the Canadian Government for the design, development and construction of facilities to produce uranium metal from pure  $UO_2$ .

**Westinghouse Electric Corp.** has a facility at its Cheswick plant for the manufacture of nuclear cores.

**Metal Hydrides, Inc.** is underwriting an "intensive research program" at Battelle for the study and development of thorium metal powder production techniques.

irradiated materials. Industry would be advised to include in these proposals a description of their plans for research and development facilities, staff and program.

Prior to this program, many organizations were actively participating in work directly or indirectly related to chemical fuel processing. The tables accompanying this Report give a brief description of their activities.

### What the Future Holds

The atomic fuel itself is too reactive to be allowed to contact the

heat removal medium, so a resistant cladding is applied. Here is real competition between the reactor designer and the reprocessor. The better the cladding for best performance in the reactor, the tougher the problem of reprocessing.

At the present time, the favored cladding materials are aluminum, stainless steel, and zirconium, but there is no assurance that a new one will not appear for the next reactor.

There is also the question of a captive processing plant—that is, one that is tied to the power plant—vs. a central processing plant serv-



Olin-Mathieson plans to build a large nuclear facility for the production of reactor components. A pilot plant is in operation at New Haven, Conn.

### Construction Metals

AEC signed up three firms to supply zirconium at an annual rate of 2,200,000 lb. for a period of 5 years, average cost is \$14 million a year. The new privately financed plants are: National Distillers Products Corp., Ashtabula, Ohio and Pensacola, Florida (1,000,000 lb.); NRC Metals, of Cambridge, Mass. New plant near Pensacola, Florida (700,000 lb.); Carborundum Metals Corp., Parkersburg, W. Va. (500,000 lb.). Former Bureau of Mines plant at Albany, Oregon, now operated by Wah Chang Corp., N. Y. (300,000 lb.). Contracts specify AEC procurement of all hafnium oxide obtained as a byproduct from the zirconium ores.

Other companies interested in this field are: Harvey Machine Co., Inc.; Horizon Titanium Corp.; Hugo Neu Corp.; National Lead Co.; Rare Metals Corp. of America; Sanford Estes and Co. Beryllium Corp. of America, Reading, Pa., and Brush Beryllium of Cleveland, Ohio, each has an AEC contract for 500,000 lb. of beryllium metal, and will build new production facilities scheduled to start operations in 1957-58. Beryllium is an important moderator or reflector in reactors.

### Rare Earth

Davison Chemical Co., a division of W. R. Grace, operates a monazite processing plant at Curtis Bay, near Baltimore, Maryland. Production is 70 to 76% thorium, 64% rare earths. They have merged with Rare Earths, Inc. Lindsay Chemical Co., West Chicago, Ill., largest producer of thorium which can be transformed to fissionable U-233.

Mallinckrodt is a subcontractor for Porter Brothers Corp., Boise, Idaho, for extracting euxenite, residues of which contain rare earths.

Maywood Chemical Co., Maywood, N. J., produces Li, Th and rare earths.

Michigan Chemical, St. Louis, Michigan, is doing research and pilot plant work for production of rare earth compounds.

Ames Lab., Ames, Iowa has conducted much research and development work on pure thorium production.

Oak Ridge National Lab. has developed a process for the separation of rare earths. This process has facilitated the production of the largest single quantity (500 grams) of europium under consideration for use in reactor control rods.

Rare Earths, Inc., Pompton Plains, N. J., processes rare earths, monazite ores, and thorium salts. Now a subsidiary of Davison Chemical.

Research Laboratories of Colorado, Inc., Newton, Ohio, operates a plant for the separation of rare earths from Norwegian gadolinite by an ion exchange method.

United States Yttrium Co., Laramie, Wyo., operates a plant for processing thalenite, a yttrium silicate, by ion exchange method. Thorium will also be available.

Vitro Corp., plans rare earths processing on a production basis with Crane Co. in a \$6 million plant in Chattanooga, Tenn.

icing many reactors. It is obvious that for some time, and for the sizes of power plants now envisioned, a central processing plant for several reactors is indicated.

Another situation still in a state of flux is the degree of enrichment\* of uranium as fuel. The hope for a large scale atomic power industry certainly lies in a system of breeding, whereby fertile material such as U-238 or thorium (as a blanket around the main core) is converted to the fissionable materials, U-233

and plutonium. An interim situation that will be characteristic of many reactors is the use of slightly enriched natural uranium fuel with a high degree of conversion of fertile U-238 to plutonium. (see tables pp. 206, 207).

### Cost Calculations

All calculations of fuel cycle costs at the present time are largely conjecture. The picture is confused by the multiplicity of fuels being used and considered, and the technology of processing has not been established for all the fuel systems that

have been conceived. However, it is possible to list the factors that give us hope for the future—a future that sees 40 large scale power reactors in operation in the U. S. by 1975. These are:

- Higher burnup in the reactor. Obviously, double the burnup requires only half the processing and roughly halves the fuel cycle cost.

- Lower cost of new fuel which in turn is based on better mining, refining, and process methods.

- Higher converting rates, and preferably, high breeding rates for fertile material.

- Uniformity of fuel compositions and cladding.

- Cheaper waste disposal means.

- Economical means of deriving credits from valuable fission products and radiations.

- Greater volume through processing plants, preferably by establishing central processing plants.

- Improved processing techniques.

### Recovering Uranium Scrap

At the present time a number of companies are engaged in reactor fuel fabrication. Much of this work is in connection with AEC projects. It's advantageous to reclaim the scrap resulting from this operation. As the industry grows, reclaiming will become a sizable business. The scrap consists largely of fuel element rejects, but also includes dross, chippings, pickling acid sludge, degraded particles, etc.

Most of the materials are associated with solid fuel elements. The manufacture of aqueous homogeneous fuel solutions will probably involve only a small amount of scrap.

### Using Fission Products and Radioisotopes

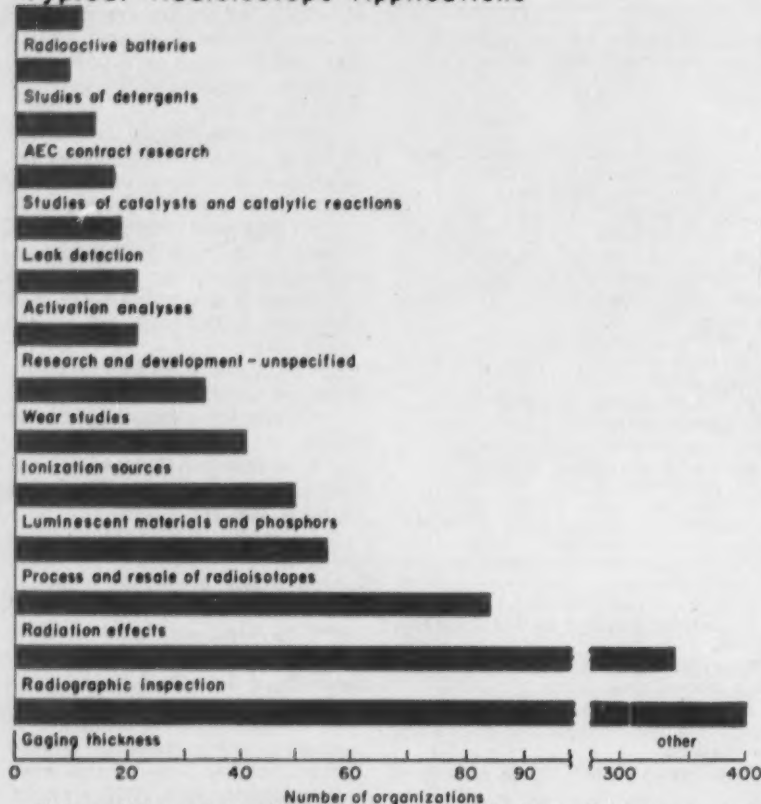
The application of fission products and radioisotopes is big business in this country.

Operation of nuclear reactors in the United States for more than a decade has resulted in the accumulation of millions of curies in waste materials from recovery operations, stored at various AEC installations. With the construction and operation of many new reactors for power production, the quantity

\*Enrichment of natural, pure uranium, with U-235. The U-235 comes from gaseous diffusion plants.



## Typical Radioisotope Applications



Single organizations employing radioisotopes in more than one of the listed applications are represented by multiple numbers. From Atomic Industrial Forum Survey covering 1946-1956

will increase at a rate faster than it can be put to use or disposed of.

At AEC request, and under its sponsorship, Stanford Research Institute conducted a study of "Industrial Uses of Radioactive Fission Products" to assist in early evaluation of an existing and growing problem. The results showed potential uses in the fields of radio-sterilization of foods and drugs, radiography, induction of polymerization reactions in the chemical industry, tracing flow in pipelines, applications in fluorescent lighting and in static eliminators.

According to AEC Commissioner Willard F. Libby, "induction of polymerization by use of gamma radiation" will probably have established its value in the next two or three years.

The usual and known processes by which polymerization is brought about are heat, pressure or by chemical catalysts. However, investigation has shown that gamma rays used in place of the conven-

tional chemical catalysts offer a number of advantages: introduction of foreign matter is eliminated; accurate control of molecular weight is possible.

Considerable progress in the field of rapid polymerization has been accomplished at Brookhaven National Laboratory. Reputedly a radiation formed polyvinylpyrrolidone has been developed that may be better for blood-extender purposes than the commercially made polymer. Radio polymerization gives precise control of molecular weight, a necessity in controlling adverse physiological reactions. Gamma irradiation also prompts esoteric chemical behavior, and may possibly polymerize heat sensitive monomers. The unpredictability of irradiation effects is shown by some polymers which become cross-linked (e.g., polyethylene), and others (e.g., butyl rubber, methylmethacrylate) which are degraded.

Many organizations engaged in

activities utilizing polymerization reactions availed themselves of Brookhaven irradiation services early in the program, and have since invested in facilities for their own research projects.

## Food Sterilization

The Army Quartermaster Corps is directing a large program for the sterilization of food with fission products, electron accelerators, radioisotopes, used fuel elements, direct nuclear radiations, and radiation from reactor coolants. Argonne National Laboratories, the University of Michigan and Swift and Co. are very active in this field. Right now we are not ready to use radio-sterilization "principally because flavor and appearance changes are not favorable."

## Applying Radioisotopes

Extensive use of radioisotopes throughout the world is evidenced by the numerous publications and literature on their utilization. The Geneva Conference further emphasized this interest during 12 sessions which covered uses of isotopes in such fields as medicine, biology, agriculture, chemistry, industry and others.

Included among the papers released at the conference was a document titled, "Isotopes—An Eight Year Summary of United States Distribution and Utilization." This extensive document covers almost every type of application and includes more than 7,000 references. According to a recent report by the AEC (19th Semi-annual Report, Jan. 1956), the total shipments of radioactive and stable isotopes to Nov. 30, 1955, numbered as follows:

No. of domestic shipments	Total
Radioactive	75,735
Stable	3,889
Shipments to AEC installations	
Radioactive	9,893
Stable	2,075
Shipments to foreign countries	
Radioactive	3,893
Stable	3,966

Without question, the maximum contribution of the peaceful atom to the general welfare of mankind to date has been made through the use of radioisotopes.

AEC Commissioner Libby has



stated: "... we estimate that \$250 million is saved annually in ordinary industrial processing." "... the economic potential of radioisotopes in agriculture now approximates \$210 million per year."

It is impossible to evaluate the scope of isotope utilization at this time; to analyze the work of just one phase, for example medicine, is a singularly major undertaking. Therefore, only the highlights will be covered.

## Industrial Utilization

The increase in isotope distribution is evidence of the striking growth in industrial use and application. In 1950 approximately 100 firms were using isotopes; as of Nov. 30, 1955 a total of 1,252 firms was using radioisotopes. In 1955 alone a total of 1,726 authorizations was issued (see chart).

Significant among the industrial developments are improved techniques in radiography, gaging devices, luminescence, ion tube operation, activation of chemical reactions, sterilization of foods, radioisotope battery development, wear studies, movement of petroleum products in pipelines, oil well logging, tracer studies and leak detection in pipes, plus many others too numerous to mention.

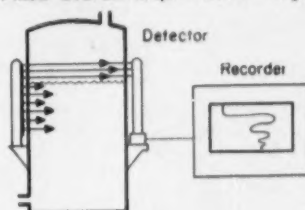
## Medical Applications

Thus far the principal applications of radioisotopes in medicine are in the fields of medical diagnosis and therapy. Primarily these are for treatment of various cancer conditions, hyperthyroidism, certain heart and ophthalmic disorders.

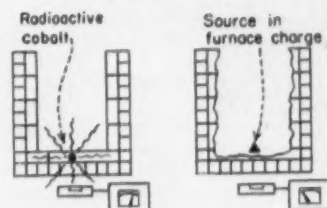
New and significant knowledge has been gained in medical and biological research with radioactive tracers. However, due to certain limitations (e.g., instrumentation, methods of measurement, etc.) further study and test are required to accomplish the transition from laboratory conditions using animals to conditions which will permit use of radioisotopes in human subjects. The isotopes used are cobalt-60 for external radiation therapy, and iodine-131, phosphorus-32, carbon-14 for internal radiation sources. The use of cesium-137 for therapeutic purposes is contemplated in a parallel program with that of cobalt-60 because of its greater

### Applying Radioisotopes

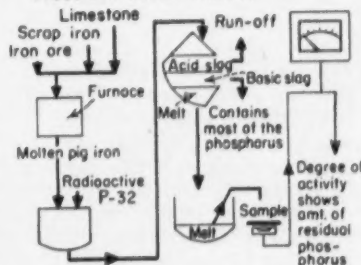
Fixed Source: Liquid Level Gage



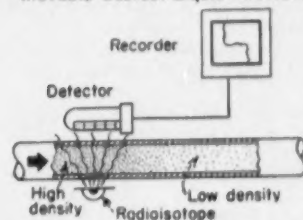
Tracer: Lining Wear



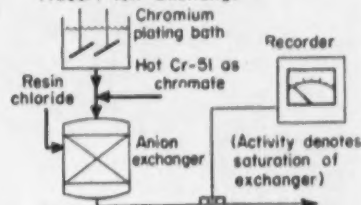
Tracer: Process Control



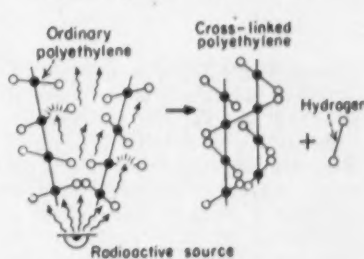
Movable Source: Liquid Interface



Tracer: Ion Exchange



Activating Chemical Reactions



half-life (37 years for cesium, 5.2 years for cobalt).

## Agricultural Uses

Studies in the field of agriculture utilizing radioisotopes cover fertilizer up-take, action of growth regulators and herbicides, plant metabolism and translocation of mineral nutrients, moisture distribution, photosynthesis, effects of radiation, and a variety of other investigations.

Brookhaven National Laboratory has instituted a cooperative program in conjunction with the agricultural experiment stations of the Eastern states, and Oak Ridge a similar program with 17 Southern agricultural stations. Studies in crop improvement are conducted with seeds and plants obtained from the experimental stations, irradiated in the pile and gamma field, then returned to the agricultural station. Improved plant varieties have been reported.

## Disposing of Wastes

Concentration, ion exchange, filtration are some of the promising methods.

During the course of nuclear fuel processing, chemical facilities generate a great volume of liquid wastes. These wastes will vary in nature and concentration depending upon the operation; they will be contaminated with radioactive substances. As a result the problem must be approached from several interrelated aspects:

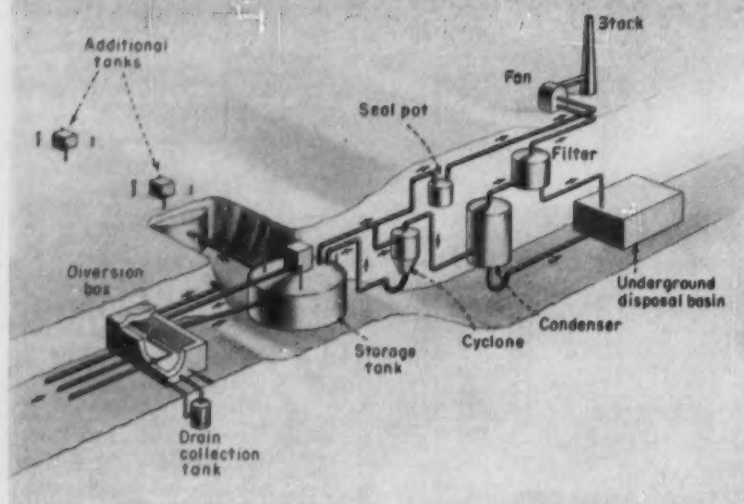
- The design and operation of equipment for collecting, and disposing of radioactive liquid wastes.
- Measures required for protection against radiation and contamination.

There is at present an urgent need for practical methods of safely disposing of radioactive waste and unused materials in the liquid form.

Much good advice has been given and is available from the Atomic



### Typical High Level Waste Storage Facility



Energy Commission on matters relating to practically every phase of handling radioactive materials.

According to Arthur E. Gorman, AEC sanitary engineer, one of the most important considerations in building a nuclear installation is suitability of site selection for eventual disposal of wastes. Also important is compatibility of operation in a populated area without danger to persons or property. In undertaking the problem of waste disposal, a critical examination of the wastes is necessary in order that they may be classified as to nature and character.

There may be alpha, beta, and gamma emitting materials in the liquid wastes, which classify them as "hot" liquid wastes (depending upon activity level) when compared to non-radioactive or "cold" aqueous wastes.

The next step is to determine what methods are best suited for measuring the quantities of waste. For example, suitable meters may be employed yielding satisfactory and accurate results in measuring a continuous stream of liquid, such as wash water. Where possible, additional techniques of waste measurement should be instituted for confirming the primary methods. Provision should also be made to cover fluctuations in other variables. The pH range and ion concentration of wastes will vary.

A study of the concentration or level of radioactivity of the contaminating substances in the wastes is the next step. As in all chemical operations, the waste may be alkaline or acid and of varying concentration. It may contain toxic substances. Some means should be provided to neutralize, treat, and remove these materials. Predetermination or forecasting of probable activity levels will be necessary. Every means of reducing wastes at the source should be considered. Further, measures will be required for protection of personnel against radiation and radioactive contamination.

The eventual transportation of "hot" liquid wastes from the buildings for final disposal involves problems of volume, weight, and radioactivity. As the volume of liquid waste per curie of radioactivity increases, the shielding and its respective weight increases greatly.

#### Corrosion Problems

Installation of a mechanical collecting system for "hot" liquid wastes must provide corrosion resistance. An unusual feature of the chemical processing operations is the high density of radiations present after the process step. These radiations accelerate corrosion so that processing and piping

systems corrode more rapidly than under normal operating conditions.

This type of corrosion involves more variables than any corrosion table can indicate and reduces the service and life of equipment. Such corrosion will be dangerous because of difficulties encountered in gaining access for maintenance and repair.

#### Water Pollution Control

Mechanical collection of specific radioactive fluid wastes for transmission to and through municipal sewage systems, as set forth by AEC regulations, is highly desirable from the standpoint of convenience and economy, but it must be done with extreme caution.

It can be determined as safe only when the subsequent residual accumulations of radioactive waste materials are at safe concentrations. Disposal in a nearby stream, river or drainage canal introduces possible pollution which must be considered. Eventual accumulation of activity in soil, vegetation or wild life may occur if high concentrations are disposed of in a water system, operating under the false assumption that a complete dilution will occur.

On the question of disposal into municipal sewage systems, the relative legal responsibility lies with the facility operator and owner.

#### Collecting and Storing

In contrast to the foregoing method of disposing of radioactive liquid wastes is the method of collecting and storing until means for ultimate disposal are developed.

Government scientists are presently working on this problem and have hopes of solving it in the near future. Collecting "hot" liquid waste for storage introduces the risk of spreading contamination, and the related dangers of radiation exposure. In addition to the need for special containers, vehicles, materials, handling equipment, etc., a number of special large storage tanks will be required. Shielding protection is necessary since the accumulation of "hot" waste brings about an accompanying increase in radioactivity.

Use of large storage tanks for holding radioactive liquid wastes is not considered entirely satisfac-



tory for the following reasons: (1) leaks may occur, with drainage onto and into the soil, thus causing contamination; (2) cumulative activity brings the possibility of boiling; (3) volume and space requirements will still be required and (5) the method is uneconomical.

It may safely be assumed that a great number of industrial facilities will be comparatively small and their resultant "hot" liquid wastes will likewise be very small in volume. Hence, the installation of sinks and piping systems to collect "hot" wastes which probably will not exceed one liter per day is an economic overindulgence. The wastes can probably be collected in suitable shielded containers at those points where they are produced and eventually transported to the large buried storage tanks. In this manner the volume can be kept at a minimum.

The final disposal of radioactive byproducts and wastes is a problem of volume reduction and concentration. Experimental tests have established that high volume reduction ratios can be obtained in concentrating wastes. Operation techniques will eventually be developed with plant scale equipment to reduce waste volumes to a still greater degree. Industrial developments have accomplished volume reduction ratios of non-radioactive chemical materials as high as 98:1.

### Industrial Procedures

Let us consider, in general, several industrial procedures now used and their possible application to disposal of radioactive liquid wastes.

Concentration, the most practical approach to the problem, is the method which offers "the line of least resistance."

Concentration of wastes, therefore, is the most logical first consideration, since the industrial equipment such as reaction vessels, flocculators, thickeners, filters and other components has already been developed to a point where design is relatively simple.

Installation of concentration equipment requires considerable space. Addition of shielding increases this requirement further. Also, initial cost is generally high, but operation costs are low.

## Major Activities in Atomic Waste Disposal

**Vitro Corp.'s** West Orange Laboratory is working on a process for a homogeneous reactor system which provides standard absorption techniques for the gaseous products, with absorption on clays for the dissolved solids. These clays are later fired at 900 to 1,000 C. to fix the fission products on the clay.

**Brookhaven National Lab.** operates a pilot plant for the fixation of radioactivity from various types of fuel wastes on montmorillonite clay to provide data for full-scale plant application.

**Johns Hopkins University** is investigating the fixation of fission product wastes on hydrated aluminosilicates.

**Oak Ridge National Lab.** has worked on the fixation of radioactivity in mixtures of natural earth materials such as limestone, shales and sodium carbonate. Radioactive decay heat as a means of accomplishing fixation is also under investigation.

**Los Alamos Scientific Lab., Argonne National Lab., and National Reactor Testing Station** (chemical processing plant) have also conducted fixation studies.

**University of California** has conducted studies covering the reaction between radioactive materials and standard earth materials by pumping wastes into wells drilled for this purpose.

**Harvard University and Technological Institute of Northwestern University** are evaluating dilution factors in streams with respect to low-level wastes.

**U. S. Bureau of Mines** is continuing work started by Harvard Air Cleaning Laboratory on the design of incinerators for disposing of 30 lb. and 100 lb./hr. of low-level combustible wastes.

The necessary modifications would include shielding, remote controls, changes in construction materials specifications to withstand high corrosion, and provisions for decontamination procedures. Maintenance and repair may become a major problem under these conditions.

**Ion exchange** offers the possibility of concentrating varied types of wastes and separating out constituents should the wastes be in the ion form. Application is favorable where concentrates are required in the liquid rather than solid form.

**Electrochemical treatment** is another system of particular interest to those concerned essentially with metallurgical wastes. Here again application is favorable where concentrates in the liquid rather than solid form are desired as a final product. The problem of disposing of the final product remains unsolved, as do its attendant hazards.

**Evaporation** may be considered where wastes are not too dilute. Those wastes which are dilute and contain volatile contaminants may be concentrated by aeration or steaming.

Since the corrosive action of radioactive liquid wastes on ordinary low cost steel is detrimental to the point of destruction, the cost of evaporator bodies constructed to resist corrosive action might make

installation prohibitive. Handling steam for concentration, or the use of aeration, involves the problems of radioactive contamination and radiation which do not make this method very feasible.

Other methods include extraction, crystallization and electrolytic action, which have limitations that make their application impractical.

### Treating Gaseous Wastes

The chief sources of high-level radioactive gaseous wastes are the radiochemical facilities which process irradiated fuel elements.

Removal of radioactive suspended particles, vapors and gases from the "hot" exhaust system before discharge to the atmosphere is a serious problem affecting all radiochemical installations needed to prevent the dangerous contamination of surrounding areas.

Studies must be made to determine the time needed for radioactive decay to safe levels, the extent to which radioactive substances may remain fixed in the environment without danger to the health and welfare of the population, and the control of dispersion or concentration.

Increasing the height of discharge stacks to improve waste disposal by dispersal in the atmosphere is, unfortunately, an illu-



### Why Atomic Power?

One question the reader may ask: Why is it desirable to produce electric power or heat by means of atomic energy, considering that other fuels can serve the purpose? The answer lies in the world-wide pressure of energy demands on limited fuel resources which come from the spectacular increases in population and industrialization. World electric power has increased at nearly 6% annually.

But the work is sharply cut out for us. At the present time the cheapest atomic powered generating plant contemplates a cost of about \$280 a kw., nearly twice the cost of modern steam plants. As to operating costs, nobody will offer a firm estimate today, but it is recognized that a considerable time must pass before nuclear plants will be able to approach the national average of 6.8 mills/kwh.

sion—the pollution from a tall stack will simply be carried to points farther away.

The gases themselves may be radioactive, containing radioactive argon or carbon. Or they may contain radioactive vapors, in which case, even 100% removal of the suspended material is not a complete solution of the problem.

In venting contaminated gases to the atmosphere, pretreatment is the rule rather than the exception.

Dry methods may utilize CWS-6 or CC-6 filter paper,\* or type 1106B Glass Fiber Web\* on equipment or apparatus such as radiochemistry hoods, canopies and caves, closed processing areas and cells. Fiber Web filters are at least 99.95% effective initially against 0.3 micron diameter particles.

Both sand beds several feet thick, and paper, have been applied as after-filters and stack discharge filters.

### Types of Gas Cleaners

Commercial equipment is on the market and widely used in industry for separating dust, mist and fume from gases on a large scale.

Such equipment includes practically all conventional types,

among them (1) filters, (2) scrubbers, (3) mechanical, centrifugal or gravitational separators, and (4) electrostatic precipitators. In most instances where radioactive suspensions are to be separated from large-volume gas streams, the separation equipment must do a very efficient job allowing much less than 1% (weight basis) of the suspended material to escape.

There are two schools of thought regarding disposal. One contends that dispersal depends on mixing with large volumes of relatively clean (non-radioactive) air to bring the activity below the maximum permissible limit. It considers the method effective as long as volumes are small and the system can control the discharge. In contrast is that philosophy which maintains that no pollutants should be released.

The problem of air pollution through radiochemical processing operations is only partially solved by the use of filter devices, no matter how efficient they may be. Disposition of the final waste from such a system presents additional problems:

- Direct burial results in re-dispersal and ground contamination, bringing with it associated problems related to the ground water table; a health hazard with area limitations and economic factors must thus be considered.

- Burning results in stack gas and particle discharge, yielding a cycle of the entire problem over again.

- Alpha-active material presents a health hazard during handling and re-dispersal and must be prevented.

- Beta-gamma active material must be discharged from the system continuously to prevent a build-up of activity, or some means must be devised for proper storage and disposal at regular intervals.

- Liquid wastes from wet systems must be evaporated, concentrated and stored.

### Reactor Design and Concepts

Materials for high temperature, corrosion, heat transfer play a big part.

It might appear that the fundamental approach to resolving the economic problems of operating a

nuclear power reactor would be one of selecting that type of reactor for which the fuel fabrication, processing and waste disposal would be greatly simplified. However, the solution is not quite so simple.

There are several basic facts and a series of technical questions, all interrelated which confront the engineers and physicists who design reactors. These concern (1) neutron economy, (2) nuclear radiation, (3) heat transfer and finally, (4) fuel processing (including fabrication and reprocessing).

Neutron economy is essential if we are to have a self-sustaining nuclear chain reaction. To maintain this nuclear chain reaction we must keep the loss of neutrons to a minimum.

Loss of neutrons may occur by complete escape from the reactor structure or by the nonfission capture of neutrons in U-238. They may be lost also by capture in structural materials, moderator or coolant of the reactor as well as by the impurities in the uranium itself. Essentially then, reactor design must provide an arrangement where the probability of neutron production is sufficient to cause other nuclear fissions, exceeding the capture or loss of neutrons by non-fission processes.

Nuclear radiations influence design considerations in several ways. High energy radiations produce changes in the physical and chemical properties of materials which they traverse, hence, the use of materials in reactor structures is limited by radiation damage.

### Accelerated Corrosion

The acceleration of metallic corrosion by radiation is an important consideration in the design and engineering phases of reactor technology.

Biological effects of nuclear radiation are also dangerous. The entire reactor must be encased in a protective shield which will prevent the escape of damaging radiation. This radiation is present not only during operation, but persists during shut-down when maintenance is necessary. Once the process of fissioning has been initiated within the reactor core, and allowed to continue for a period of time, the fuel elements and various internal parts of the reactor become highly radioactive, neces-

\*Mine Safety Appliance Co. trade name.

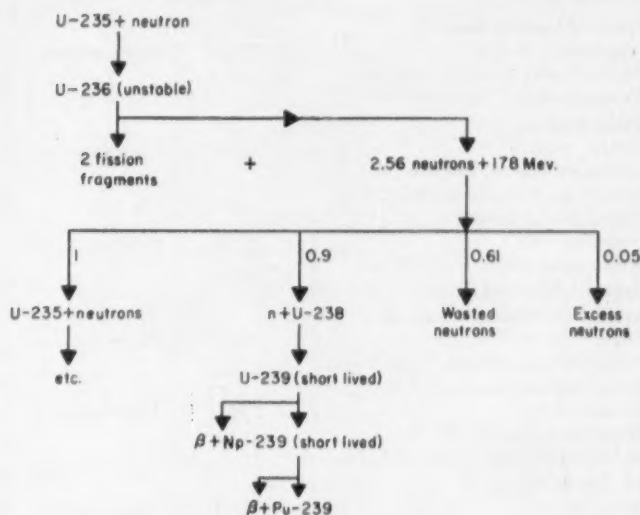


sitating remote control and operation.

A word or two about control: The entire complex nuclear cycle must be controlled for start-up, operation, and shut-down. The length of time that fuel can remain in the reactor is important from the standpoint of over-all fuel economy.

Fissioning processes release tremendous amounts of heat energy. The conversion of this energy to power and its utilization are the principal reasons for interest in the atomic power reaction. Although the basic heat transfer problems are the same as for conventional fuel (coal, gas, etc.), there are those differences already mentioned, i.e., radiation, corrosion and neutron economy, which create major barriers in reactor engineering. They will probably be solved mainly by chemical engineers.

## How Uranium Fissions



## Need for Variety

No one single type of reactor will satisfy the variety of our needs.

The AEC has initiated a reactor development program covering the types of reactor designs that look promising for commercial power. Let's review the objectives of each reactor concept and the related programs, as set forth by Kenneth Davis, AEC director of reactor development before the Joint Congressional Committee on Atomic Energy (see tables next page).

**PWR (Pressurized Water Reactor)**—Will provide reliable cost data covering design, construction, operation and maintenance for central-station nuclear power plants.

**BWR (Boiling Water Reactor)**—Aim of this experiment is the construction and operation of a minimum capacity plant to assist sound extrapolation to large size central-station power plants.

**SRE (Sodium Reactor Experiment)**—Will provide a firmer basis for estimating the performance and economics of this type of plant.

**EBR (Expt. Breeder Reactor)**—Objective is the development of reactors capable of producing more fissionable material than they consume. EBR No. 1 at the National Reactor Testing Station, in operation since 1951, will provide accurate data for the detail design of the core.

**HRE (Homogeneous Reactor Experiment)**—Indicates a uniform

core material, such as a solution or slurry. This distinguishes such reactors from those with a core composed of different materials (solid elements) separated from each other. This experiment will provide the technology necessary to take advantage of low cost (simplified design), economical chemical processing, and the elimination of fuel element fabrication.

**LMFR (Liquid Metal Fueled Reactor)**—This concept involves the development of a non-aqueous fluid fuel system and reactor to provide high temperatures and low pressures common to liquid-cooled systems, together with simplified fuel processing.

**OMRE (Organic Moderated Reactor Experiment)**—Objective of this experiment is to determine the advantages of organic compounds as reactor moderator-coolants. These advantages include low induced radioactivity, low corrosion of fuel elements, high boiling points and consequent lower vessel pressures with practically no corrosion problems. After evaluation of certain unknowns and satisfactory systems analysis and test, the experiment will be designed to simulate conditions of heat flux, temperature, and coolant velocities contemplated for a power reactor of this type.

**Gas-cooled Reactor**—Objective of this experiment is directed toward determining whether such systems

will be suitable for the needs of both small central stations and mobile nuclear power plants. Studies are directed toward the design of fuel elements suitable for high temperature operation, coupled with a reasonable life (see p. 114).

**Water-Graphite Reactor**—Latest reactor to be included in the program. This type has a number of advantages and will provide data for reactors using both uranium and plutonium.

## Chemical Engineering Problems

Reactors delivering atomic power must work at elevated temperatures to secure a reasonable thermodynamic efficiency. As a result, materials must operate at such temperatures. The chemical engineer's role, therefore, centers on the chemical reactions which occur at these elevated temperatures.

There is now no adequate backlog of basic chemical information at elevated temperatures, despite the excellent work done in recent years at Oak Ridge and other laboratories.

It is not possible to predict with any reliability the relative volatilities, thermodynamic free energies, or even the molecular formulas of the compounds which are likely to result from a given mixture of elements heated at temperatures of 500 to 1,000 C., or above. Engineers interested in the development of



# Industrial U. S. Atomic Power Plants—An Ambitious Program

Program	Scheduled for Operation	Type	Fuel and Fuel Elements	Core Structural Material	Blanket
<b>Advanced Construction</b> Shippingport, Pa.† Pressured water reactor, 60,000 kw. Westinghouse and Duquesne Light	1957	Heterogeneous	Natural U-rods, 90% enriched U-plates	Zircaloy-2	Natural uranium
<b>Ground Broken</b> Monroe, Mich.† Fast breeder reactor, 100,000 kw. Power Reactor Development Co., Inc. (Detroit Edison and others)	1960	Heterogeneous	Natural uranium, 20% enrichment		Depleted uranium
Livermore, Calif.* Boiling water reactor, 5-10,000 kw. General Electric and Pacific Gas & Electric	1958	Heterogeneous			
<b>Construction Permits Received</b> Indian Point, N. Y.* Pressurized water reactor, 150,000 kw. Consolidated Edison Co., B & W	1960	Heterogeneous	Uranium and thorium, 90% enrichment	Zircaloy-2	Thorium
Dresden, Ill.* Boiling water reactor, 180,000 kw. Commonwealth Edison Co., G. E., Bechtel	1961	Heterogeneous	Natural uranium, 1.1% enrichment		
<b>AEC Contract Signed</b> Rowe, Mass.† Pressurized water reactor, 134,000 kw. Yankee Atomic Electric Co., Westinghouse, Stone & Webster	1960	Heterogeneous	Natural uranium, 2.7% enrichment	Stainless	
<b>Approved Contract Negotiation</b> Beatrice, Neb.† Sodium graphite reactor, 75,000 kw. Consumers Public Power District, Atomics International	1960	Heterogeneous	Natural uranium, 1.8% enrichment	Zirconium	
Elk River, Minn.† Boiling water reactor, 22,000 kw. Rural Cooperative Power Assn., AMF	1960	Heterogeneous	Fully enriched spikes. Natural uranium core		
Hemey, Mich.† Aqueous homogeneous reactor, 10,000 kw. Wolverine Electric Coop., Foster Wheeler	1959	Homogeneous	Fully enriched U-235		
Anchorage, Alaska† Sodium cooled, heavy wtr. moderated 10,000 kw. Chugach Electric Assn., Inc. Nuclear Development Corp. of Amer.	1962	Heterogeneous	Natural uranium, 2% enrichment		
Piqua, Ohio† Organic moderated reactor, 12,500 kw. City of Piqua, Atomics Int'l.	1960	Heterogeneous	Natural uranium, 3% enrichment		
<b>Under Consideration</b> Gainesville, Fla.† Pressurized water reactor, 2,000 kw. University of Florida, Alco.	1959	Heterogeneous	Natural uranium, 30-40% enrichment		
Holyoke, Mass.† Gas cooled reactor, 15,000 kw. City of Holyoke, Ford Instrument	1961	Heterogeneous	Natural uranium, 5% enrichment		
Orlando, Fla.† Liquid metal fueled reactor 25-40,000 kw. City of Orlando	1961	Heterogeneous	Liquid metal, fully enriched U-235		
Eastern Pa.* Aqueous homogeneous reactor, 150,000 kw. Penn. Power and Light, Westinghouse	1962	Homogeneous		Stainless	
Florida* Bismuth-graphite, 200,000 kw. Florida power companies, B&W, Allis-Chalmers	1962	Heterogeneous			

†Joint AEC-Industry sponsored project  
\*Privately financed project



## U. S. Government Experimental Reactor Program Points the Way

Program	Scheduled for Operation	Type	Fuel and Fuel Elements	Core Structural Material	Blanket
<b>Built and Operating</b>					
Oak Ridge, Tenn. Homogeneous reactor expt. 2,000 kw. Oak Ridge National Lab.	1956	Homogeneous	About 90% enriched U as $UO_2SO_4$	Zr alloy tank	Thorium
Los Alamos, N.M. Power reactor expt. I & II Los Alamos Scientific Lab.	1956	Homogeneous	Uranyl phosphate, 90% enrichment		
<b>Under Construction</b>					
Santa Susana, Calif. Sodium reactor expt. 7,500 kw. North American Aviation for AEC	1957	Heterogeneous	Uranium rods, 2.9% enrichment	Stainless	
Lemont, Ill. Experimental boiling water reactor 5,000 kw. Argonne National Lab.	1957	Heterogeneous	Natural U, 1.4% enrichment		
National Reactor Testing Station in Idaho Organic moderated reactor expt. North American Aviation for AEC	1957	Heterogeneous			
National Reactor Testing Station Boiling reactor expt. 4	1956	Heterogeneous	Natural uranium		
<b>Planned</b>					
Liquid metal fueled reactor Brookhaven Nat'l. Lab, B & W	1959	Heterogeneous	Molten U-Bi	Graphite	Thorium
Gas cooled reactor Aerojet-General at NRTS	1958	Heterogeneous			
National Reactor Testing Station Experimental breeder reactor 15,000 kw. supervised by Argonne National Lab.	1959	Heterogeneous	90% enriched U		
Los Alamos, N. M. Molten plutonium reactor expt.	1959		Molten Pu alloy		

Wherever possible every effort has been made to ensure reliability of information shown. However, due to the rapid changes in reactor technology complete accuracy cannot be guaranteed. Blank spaces indicate information unavailable at this date.

jet engines, as well as several other groups in industry, have contributed sizable amounts of information, but the sweep of the whole field is so great that large areas exist where nothing is known.

Another problem of concern to chemical engineers is the question of corrosion in the various atomic power reactors being designed, built and considered.

### Chemical Engineer's Reactor

Homogeneous reactors embrace a family of reactors which may include anything in the way of fluidized or dissolved liquid fuels, with fixed or moving moderators, with or without continuous processing of the fluid fuel as it circu-

lates through the reactor. There are many possible variations—for example, those using uranyl nitrate in water or liquid uranium-bismuth alloy. Because his instinct is to handle fluids, the homogeneous reactor is the chemical engineer's reactor. It will probably be a chemical engineer who makes it work; quite possibly it will be a type of homogeneous reactor that will give the cheapest atomic power in the end.

We are at the point now where most of the reactors being built in Britain, Russia and the United States are heterogeneous, mainly since there is a large backlog of experience with solid fuels. Even though the homogeneous reactor appears to have the best chance, it

brings up some very severe corrosion problems which have yet to be solved.

A new and interesting type of heterogeneous atomic power plant is the "fast breeder" in which the neutrons produced by fission reactions are not allowed to lose energy by collision with graphite or heavy water, but are reacted in their energetic state with U-238 or thorium in the breeder "blanket." Because of the high energy, neutrons are able to produce Pu-239 or U-233 in sufficient yield so that more fissionable material is produced than is consumed. This concept has been established experimentally.

Breeding, of course, is a concept used in the homogenous reactor.



## Major Companies in the Reactor Program

### Power Reactors

**Studebaker-Packard Corp.** and **Ford Instrument Co.** have been awarded AEC study contracts to provide information covering the economic potential of the gas-cooled power reactor. **Aerojet-General** will design and operate gas-cooled reactor experiment at National Reactor Testing Station.

**Raytheon Manufacturing Co.** has been working on the conceptual design of a gas-cooled liquid-metal-fueled reactor using the fuel concept developed by Brookhaven (uranium-bismuth solution). The reactor power range would be 5,000 to 60,000 kw. of electricity.

**General Electric Co.**, at Hanford, has been requested by the AEC to "submit plans for a research and development program covering the use of plutonium in the operation of thermal-heterogeneous power reactors."

**GE at Pleasanton, Calif.**, in new design, engineering and production facilities, will construct a prototype single-cycle boiling water reactor to operate at an initial 8,000 kw. electrical. This unit will be the experimental prototype of the 180,000 kw. electrical plant for Commonwealth Edison, Chicago. At a later date the prototype power output will be increased and the reactor sold to Pacific Gas & Electric. In addition GE has the Knolls Atomic Lab. at Schenectady, N. Y., for basic research.

**Atomic Power Development Associates, Inc.** has invested more than \$8 million in studies, research and development toward electric power generation by nuclear energy. Additional investment at the rate of \$5 million annually is anticipated in 1956-57. The APDA project is working on a fast breeder design.

**Oak Ridge National Lab.** presently has the major responsibility on the aqueous homogeneous power reactor effort. Testing is in progress.

**Los Alamos Scientific Lab.** is conducting studies on homogeneous reactors using uranyl-phosphate solutions. Experiments are in progress.

**Brookhaven National Lab.** has been conducting research on the basic technology of the liquid-metal-fueled reactor. This reactor uses molten metal as a uranium transporting agent. Another variation uses molten uranium-bismuth alloy as a fuel and graphite as the moderator.

**Babcock and Wilcox Co.** is directing studies to evaluate the Brookhaven concept and design of the LMFR in conjunction with 17 other organizations.

**Atomics International** is participating with AEC in the development of an organic-moderated reactor. Estimated cost is \$2 million of which the company will contribute \$750,000. Completion of an experimental reactor is expected late 1957 at the NRTS, Idaho. Also Atomics International is constructing the sodium reactor experiment at Santa Susana, Calif.

**Alco Products Inc.** is constructing the Army Package Power Reactor (APPR) at Ft. Belvoir, a prototype of military units to supply 3,000 to 6,000 kw. of steam and approximately 1,000 to 2,000 kw. of electric power. Alco has opened a new reactor criticality facility at Schenectady, N. Y.

**Westinghouse Electric Corp.** designed the Shippingport, Pa., PWR station for Duquesne Light. It will build a 134,000 kw. electrical PWR power plant for the Yankee Atomic Electric Co. Architect-engineer for the latter is Stone and Webster Engineering Corp. The reprocessing of spent fuel elements will be accomplished by the AEC. Westinghouse is developing a new core design utilizing stainless steel for structural purposes.

**Nuclear Power Group** has been studying the feasibility of a homogeneous reactor concept since November 1955 in a joint venture with Babcock and Wilcox. Each organization has contributed approximately \$200,000 and 8 to 10 technicians working full time. The objective is to design a modified ORNL homogeneous reactor by eliminating the core vessel and the slurry breeding blanket, thus minimizing corrosion and instability.

**Vitro Corp. of America** has a contract for two research reactors for the Corps of Engineers, Ft. Belvoir, Va.; a contract to design Consolidated Edison's nuclear power plant near New York (except for the reactor); a contract for GE's ANP test facilities engineering and design; and is designing Lockheed's A-plane reactor facilities in Dawsonville, Ga.

**Republic Steel Corp.** has studied several different reactor types as a possible source of power and heat to operate blast furnaces.

**Combustion Engineering Corp.** is developing and building a SRS (submarine reactor small) pressurized-water type reactor. Major development work will be accompanied at Combustion's Windsor, Conn., facility.

**Glenn L. Martin Co.** will build a PWR 13,000 kw. electrical for the Dominican Republic at Ciudad Trujillo.

**American Machine & Foundry Co.** is conducting studies covering development of "special-purpose low-power" reactors for new applications of both industrial and military nature. Also will engineer a boiling water reactor for Rural Cooperative Assn. at Elk River, Minn.

## Manpower and Training

The nuclear industry promises to compete seriously for chemical engineers.

The biggest problem for the atomic energy industry today is the shortage in the supply of skilled and experienced manpower. Demand exceeds the supply as evidenced by want ads, concentrated employment recruiting programs, and the like, instituted by almost every major chemical and engineering firm in the country.

To further emphasize how acute the problem has become, the familiar statistical comparison of scientific and technical graduates in the U.S. and Russia has been made repeatedly. Between 1928 and 1954 Soviet Russia graduated 682,000 scientific and technical specialists, the U.S. 480,000.

Recent studies by the National Science Foundation, the Bureau of Labor Statistics, the National Committee for the Development of Scientists and Engineers, and other organizations, indicate that the U.S. educational institutions have not kept pace with the demand for personnel in the nuclear field.

Today, there are over 5,000 nuclear technologists in the atomic industry. However, these 5,000 are only a fraction of a percent of all the scientists and engineers at work on research and development in the U.S., according to AEC Chairman, Lewis L. Strauss. At present we are training fewer than 500 persons a year, with a current need of three to four times this number.

A recent survey conducted by the Manufacturing Chemists' Association indicated that the growth in the nuclear field will compete seriously for the anticipated supply of chemists and chemical engineers. The content and significance of the report were considered important enough to enter into the Congressional Record. Two of the questions among the eight specific ones placed before the Association's members covered technical manpower and educational requirements.

The survey indicated that "the appeal of the new and unknown," in contrast to the more prosaic types of science, was today attracting 10% of chemists and chemical engineers. This new demand of the nuclear field will further decrease



the supply of scientists available for the balance of industry and for teaching.

### Educating Engineers

As regards educational requirements, the survey indicated that drastic changes in the standard science courses would be both unwarranted and undesirable. In general, it was the opinion that colleges and universities are making satisfactory headway in dealing with this new challenge, and that the field of nuclear science, as such, should not have a major effect upon current fundamental training programs.

Conservative estimates\* indicate that in 20 years the U.S. will be generating over 83 million kw. of electricity from atomic energy. This means our personnel needs will be at least 23,000 engineers and scientists or nearly five times the present figure. If we add the requirements of the government's military and naval program, our figure will jump to 30,000 or more.

Although no clear-cut policy defining its position on technical manpower requirements has been stated, the AEC encourages and assists the entire program, military and civilian, by

- Providing fellowships in radiological physics, industrial hygiene, and medicine.
- Offering courses at Oak Ridge and Argonne National Laboratories.
- Providing technical information and assistance to industry and universities.
- Informing industry, universities and professional societies regarding manpower requirements.
- Training engineers, technicians, operators and other skilled craftsmen.

### Insurance and Licensing

Protective measures become more urgent as civilian participation increases.

With the rapid development and growth of the atomic energy industry, it is of vital importance that the welfare and safety of the public be protected. In addition, financial protection must be provided in the event of a disaster for

\*McKinney Report on "Peaceful Uses of Atomic Energy" Vol. 2, Ch. 13 (1956).

## Reactor Program (Continued)

**Bethlehem Steel Co.**, with extensive shipbuilding facilities, has conducted preliminary studies of present nuclear reactor power concepts in relation to marine propulsion plants, small stationary electric power plants and distillation plants.

**Foster Wheeler Corp.**, Pioneer Service & Engineering Co. and Diamond Alkali Co. have conducted studies on the feasibility of a reactor design based on fluidization techniques as employed in the petroleum industry. Present program covers preliminary proposal design of aqueous homogeneous thorium breeder systems to be completed in 1956.

**Newport News Shipbuilding & Dry Dock Co.** is directing major efforts toward merchant-ship propulsion by nuclear power. Preliminary studies have been made of pressurized-light-water reactor power plants.

**Tennessee Valley Authority** has been conducting studies since November 1953 on the application of nuclear power reactors to the TVA power system. Their present program includes investigation of circulating-fuel systems characteristic of the aqueous homogeneous reactor because of the potential low fuel cost.

**Nuclear Development Corp.** was awarded a \$100,000 study contract by the U. S. Army to study nuclear power applications for harbor craft, railroad and overland cargo carriers. NDC in association with General Motors Allison Division is working on the design of a nuclear powered aircraft engine for the Navy. Also NDC is the design-engineer for the Anchorage, Alaska, sodium-cooled, heavy-water-moderated power reactor.

**Foster Wheeler Corp.**, after intensive studies and investigations, announced in April 1955 that it was prepared to design and build, for completion by 1960-1961, a central station nuclear power plant utilizing the aqueous homogeneous breeder concept. Will engineer an aqueous reactor for Wolverine Electric Corp. at Hersey, Mich.

**General Dynamics Corp.**, builder of atomic-powered submarines, is investigating application of small power reactors for future design and fabrication of such units.

### Research and Test Reactors

**North Carolina State College** (of the Consolidated University of North Carolina) has operated a research reactor since September 1953, the first university research reactor.

**Pennsylvania State University** placed its research reactor in operation in 1955.

**University of Michigan** has a research reactor in process of construction. **Armour Research Foundation** is operating a 50-kw. solution-type research reactor. The unit was manufactured by **Atomics International**. Studies will be conducted on the application of atomic techniques.

**Battelle Memorial Institute**, in conjunction with **Esso Research and Engineering Co.**, is establishing a non-government atomic research center. A "swimming-pool" reactor will be utilized for studies covering atomic energy applications in the oil industry.

**Naval Research Lab.** has completed a 100-kw. "swimming-pool" research reactor in Washington, D. C.

**American Machine & Foundry Co.** is installing a 1.0-megawatt "swimming-pool" type research reactor; completion is anticipated this year.

**Gamma Corp.** anticipates completing installation of a 0.5-1.0 megawatt water-boiler type research reactor this year.

**General Dynamics** has selected San Diego, California, as the location for its atomic laboratories where studies will be conducted to simplify design and increase efficiency of reactor systems.

**University of California** at Los Angeles, Medical Center, plans a reactor for medical and therapeutic application. The unit is to be constructed by **Atomics International**, at an approximate cost of \$185,000. The reactor will be a homogeneous type, using uranium sulfate as fuel and operating at 50 kw. Completion is expected in two years.

**Westinghouse Electric Corp.** will place in operation a privately owned test reactor at Pittsburgh, Pa., in 1957, generating the heat equivalent of 20,000 kw. It will use water as a coolant and moderator, and will be capable of irradiation testing of materials and components.

**Phillips Petroleum Co.** operates **Materials Testing Reactor** at Arco, Idaho, for the AEC. In addition the AEC National Laboratories each have testing reactors.

**Aerojet-General**, San Roman, Calif., produces small, low power nuclear reactors for training and experimental uses.

**Dow Chemical Co.** plans to build a liquid fuel test reactor for research and development at Midland, Mich.



those organizations and personnel directly engaged in nuclear work.

To overcome these initial difficulties, the Atomic Energy Act of 1954, and supplemental legislation, was enacted covering licensing, operation, and prescribed standards for protection against radiation hazards.

The proposed and existing regulations have been published; the Federal Register (under Notice of Rule Making) is available for public perusal so that comment may be submitted before proposed rulings become effective. On January 3, 1956, a regulation covering "Operators' Licenses" was published in the Federal Register, to become effective 30 days thereafter. Similarly, the Commission's regulation for licensing reactors and other facilities went into effect February 18, 1956.

Although experience gained in the past 10 years in atomic energy has indicated that reactors, chemical processing plants and associated facilities can be operated safely, several basic problems must be resolved. Many have already been mentioned in this Report. Nevertheless, the major ones will be reviewed to present a more comprehensive picture of the situation:

- Establishing codes, standards and regulations as a basis for determining whether the public and operating personnel are being protected.
- Developing adequate definitive codes, standards and regulations pertaining to proposed design and construction by type and classification of nuclear facility.
- Providing safety codes and regulations pertaining to operation and maintenance of nuclear facilities, by classification and type.

To develop such a series of protective and safety measures, a detailed hazard evaluation has to be made.

Each evaluation, of course, will be characterized by certain basic similarities. However, there will also be differences peculiar to each nuclear installation depending upon type, classification and operation. For example, there are nine reactor concepts under development, each different from the other: This means different fuels, cooling systems, blanket or moderator materials, operating power levels, controls, wastes, etc. Anticipated application of nuclear energy for

power includes central station power plants, aircraft propulsion, merchant ship propulsion, railroad and overland cargo carrier applications—all presenting numerous ramifications of the problems involved.

As civilian applications for licensing are approved, atomic industry will become more widespread, with new problems of state and municipal controls and regulations.

Duke University's publication, *Law and Contemporary Problems*, recently printed an article titled "The Role of the States in Atomic Development." It lists some 22 agencies in the state of Massachusetts alone which, the authors contend, will probably find it necessary to enlarge their sphere of activity to include atomic energy phases.

The commission is aware of the states' role in public health and safety, consequently has maintained close coordination and liaison. An Advisory Committee of State Representatives has been established to work with the AEC and develop radiation protection regulations.

### Insurance

What is probably the most comprehensive report by private industry released so far is titled: "Preliminary Report on Financial Protection Against Atomic Hazards." It was prepared for the Atomic Industrial Forum, Inc., by Columbia University, and is an excellent start on the evaluation of a complex of problems.

During May 1956 the Joint Congressional Committee on Atomic Energy held open hearings on legislative proposals for government indemnity, which would supplement private insurance. The hearings produced two bills: the Anderson bill, prepared by the Joint Committee staff, which proposes amendments to the Atomic Energy Act of 1954, and the AEC bill dealing with the insurance problem.

As a result of these hearings the Joint Committee is now considering a bill that would require the Commission to set the amount of financial protection to cover third party liability claims as a condition of granting a reactor license.

The bill states that "such financial protection may include private insurance, private contractual in-

demnities, self-insurance, or a combination of such measures." The liability insurance pool would amount to approximately \$65 million coverage for each insured project. According to the insurance industry, this unprecedented sum is more coverage than that written in any known single instance in the history of liability insurance. Under the bill the AEC would be required to indemnify the licensee up to \$500 million.

### A Look Into the Future

The commercial nuclear industry is fast getting to be big business with the accent now on engineering improvements.

Much work has already been accomplished on improved designs and processes, as we've shown in this Report. But practically nothing has been finalized. There is tremendous room for improvement, particularly in chemical processing and equipment design, for example:

- Developing and producing new and improved materials to withstand the special high-temperature and corrosive conditions prevailing inside reactors.
- Designing and fabricating fuel elements (solid or liquid) which combine simplicity, long life, resistance to degradation, ease of chemical reprocessing, low cost.
- Using atomic reactors for process heat and as integral parts of chemical processes.
- Developing improved methods for recovery of reactor fuel and for separation of fission products.
- Improving the efficiency and operation of atomic reactors.
- Improving methods for handling and disposing of radioactive wastes.

The AEC estimates (p. 209) we will have 83 million kw. of installed nuclear generating capacity in the U.S. within the next 20 years—a great opportunity for bold and imaginative chemical engineers and chemical companies.

### REPRINTS AVAILABLE

Extra copies of this 20-page report are available at 50¢ each. Check off Reprint No. 89 on the Reader Service postcard inside the back cover.



## Chemical Engineering Fundamentals

## Physical Equilibrium for Equipment Design—II

How to understand physical equilibrium data and use them to best advantage. Thermodynamics points you in the right direction.

JAMES O. OSBURN, State University of Iowa, Iowa City, Ia.

**E**QUILIBRIUM between phases is something that we can predict with the help of the phase rule. We discussed this in last month's installment (*Chem. Eng.*, Nov. 1956, p. 223). This month we'll apply the prediction technique to one-component systems and to mixtures of two components. Future issues will explain more complicated situations.

First we'll show how proper use of the phase rule helps us plot our data correctly. Then we'll explain how the science of thermodynamics can help us to interpret, evaluate and use our data.

## Who Uses One-Component Diagrams?

Do you plan to purify a fairly pure substance by recrystallizing it from a melt?

Are you going to design tanks for storing volatile liquids with high vapor pressures?

Are you interested in the new field of extremely-high pressures, where graphite changes to diamond and where many other new substances—as yet unknown—certainly must exist?

If you are, then you will be using one-component diagrams.

## How Pure Substances Act

The simplest case of physical equilibrium is that of a pure substance, or in other words, one-component systems. Actually, this case is not as rare as you might think.

Of course, we must admit that probably nothing is ever absolutely pure. But you will often encounter materials where the impurity concentrations are low enough to be considered negligible from the engineering point of view. When we have finished a separation process, we have a relatively pure material that we must handle and store. Again, when we use heat transfer media we are usually working with pure substances.

In both of these cases we have to understand the phase behavior. Equally important, we will study two- and three-component systems by comparing them with pure substances.

If your problem involves colloidal material with a high specific surface, or if you are working with an electrical or radiation field, look out. The

surface or radiation effects will change the equilibrium picture. In this discussion we are going to rule out all effects except temperature, pressure and composition.

## How to Plot Your Data

When we gather physical equilibrium data, a very important part of the job is to plot these data in a form that's easy to understand and easy to use.

For one component the concentration is always 100% because we have only one substance. The remaining variables are temperature and pressure, and they can be represented on a plane. The phase rule tells us that the number of degrees of freedom is  $3 - P$ .

Fig. 1 on the following page shows what a typical pressure-temperature diagram for a pure substance might look like. Note that the pressure scale has been made logarithmic to cover a wide range of conditions. On this diagram you will notice these characteristics of one-component equilibrium:

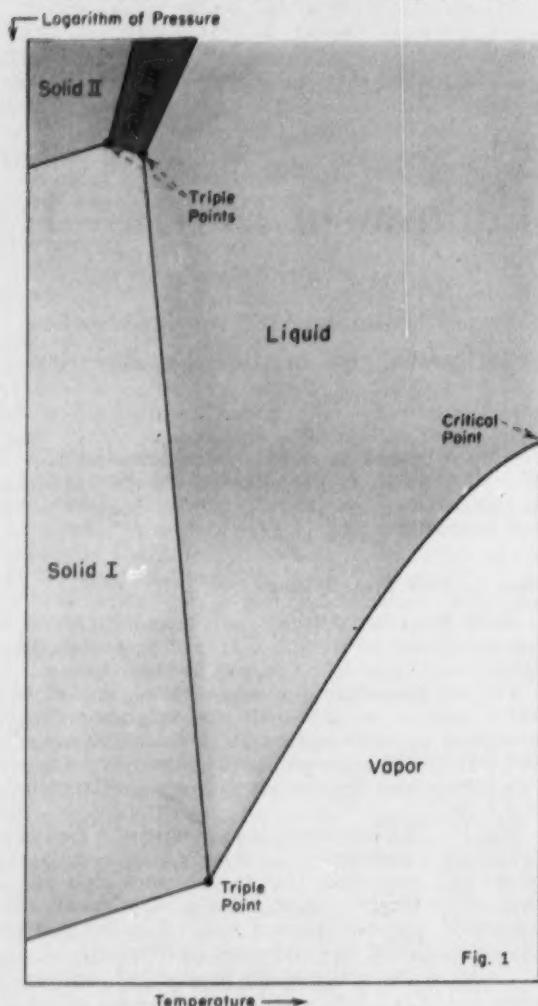
- Areas that indicate the presence of only one phase.
- Lines that indicate existence of an equilibrium between two phases.

## Nomenclature (Consistent Units)

$A, B, C$	Constants in the Thodos equation
$A, B$	Components in a system
$C$	Number of components
$d$	Differential operator
$F$	Degrees of freedom
$H$	Latent heat of a phase change
$K$	Equilibrium vaporization ratio
$p$	Partial pressure of
$P$	Degrees of freedom
$P$	Vapor pressure of
$R$	Universal gas constant
$T$	Absolute temperature
$V$	Volume
$x$	Mole fraction in the liquid phase
$y$	Mole fraction in the vapor phase
$\alpha$	Relative volatility
$\Delta$	Finite increment of
$\Delta$	Constant in the Thodos equation
$\gamma$	Activity coefficient
$\pi$	Total pressure



## Pure Substances Exist in Many Phases



• Points that show equilibrium between three phases.

• An end of equilibrium at the critical point.

At low temperatures and pressures we find equilibrium between a solid and a vapor. This shows up as a line on our diagram and indicates that we have freedom to choose temperature or pressure—within limits—but not both:

$$F = C + 2 - P$$

$$F = 1 + 2 - 2 = 1$$

The lower limit of this equilibrium line between solid and vapor is where the temperature approaches absolute zero. As temperature increases a third phase appears. This can happen at only one fixed set of conditions, since there are zero degrees of freedom:

$$F = 1 + 2 - 3 = 0$$

This point is the triple point.

Above the triple point there is equilibrium between liquid and vapor. And the upper limit of this

equilibrium is the critical temperature. Above the critical temperature we find only one phase, unless a solid appears at very high pressures.

Equilibrium between liquid and solid—the melting point curve—usually shows a very large slope. This slope may be either plus or minus. At very high pressures, other triple points are found. These always involve three phases and are due to new and different solid phases that are stable at high pressures.

## Equations Define Equilibrium

Although engineers like to work with graphs, we also need equations for:

- Interpolation. Calculations of intermediate values are more accurate.
- Extrapolation. A little data goes a long way.
- Machine calculation. Digital computers work with equations.

The shape of an equilibrium curve is described by the Clapeyron equation:

$$dP/dT = \Delta H/T\Delta V \quad (1)$$

This single equation applies to all cases of phase equilibrium.

For example, it will predict the direction of the liquid-solid equilibrium curve. The heat of melting,  $\Delta H$ , is always positive. If the density of the solid is higher than that of the liquid, then  $\Delta V$  for melting is positive and the equilibrium curve has a positive slope. If the density relationships are reversed, the slope is negative.

Applying the Clapeyron equation to vapor-liquid equilibrium, we first make these three assumptions:

- That  $\Delta H$  is a constant.
- The volume of the liquid is negligible.
- The gas is ideal, so that  $V = RT/p$ .

With these three assumptions, the Clapeyron equation becomes:

$$dP/dT = \Delta H/T(RT/p)$$

or,

$$dP/dT = (\Delta H/R) (dT/T^2) \quad (2)$$

Integration gives us the Clausius-Clapeyron equation:

$$\log P = -(\Delta H/2.3 RT) + B \quad (3)$$

Over small intervals of temperature (not too near the critical temperature), the assumptions are good and Eq. (3) applies quite well. For larger intervals (and near the critical temperature), the assumptions are not valid. Instead, you have your choice of several modifications of Eq. (3). For further information we refer you to the short article by Worden Waring in *Ind. & Eng. Chem.*, 46, p. 762 (1954).

You can understand how handy it would be if you could calculate the vapor pressure curve from only one or two easy measurements, say from the boiling point. The equation developed by Thodos [*Ind. & Eng. Chem.*, 42, p. 1,514 (1950)], is a step in this direction. Thodos' equation is

$$\log P = A + (B/T) + (C/T^2) + \Delta$$

where the constants  $A$ ,  $B$ ,  $C$  and  $\Delta$  are functions of the normal boiling point.

Therefore, from the simple experimental measurement of the normal boiling point, the entire vapor



pressure curve for a normal saturated hydrocarbon can be calculated to a high degree of accuracy.

### How Two-Component Systems Act

We work with mixtures more often than we work with pure substances; and the simplest mixture is one with two components. To start, let's consider the phase behavior of two-component systems.

With a second component, the situation becomes more complicated than with only one component. There is an extra degree of freedom:

$$F = 2 + 2 - P = 4 - P$$

On our equilibrium diagrams we must show another variable in addition to temperature and pressure. This additional variable is composition and we'll need three dimensions to represent the equilibrium completely.

Three-dimensional drawings are not easy to construct or to work with. Fortunately, it usually isn't necessary. Most of the time a separation process is carried out either at constant temperature or constant pressure. To describe such a process, we need only two dimensions to represent equilibrium.

On such a reduced diagram, the freedom is reduced one degree. These combinations of our variables are possible:

- Plot  $P$  vs.  $x$  and  $y$  at constant temperature.
- Plot  $T$  vs.  $x$  and  $y$  at constant pressure.
- Plot  $P$  vs.  $T$  at constant composition.
- Plot  $x$  vs.  $y$  at constant pressure.
- Plot  $x$  vs.  $y$  at constant temperature.

We illustrated the first three of these combinations last month (*Chem. Eng.*, Nov. 1956, p. 223).

In most cases of vapor-liquid equilibrium, the familiar  $x$ - $y$  diagram is the most useful.

### Watch for Retrograde Condensation

Lowering the pressure on a material at constant temperature usually results in vaporization. However, there is a situation where the reverse happens. This peculiar situation, associated with two-component mixtures, is called retrograde condensation. Here is how it occurs.

The upper limit for two-component equilibrium is the critical temperature. There is a different critical temperature for each different total composition. In Fig. 3 we see the critical temperatures for two pure materials, A and B, and the critical temperature for a particular mixture of A and B.

Now for mixtures we define the critical point as the temperature where liquid phases are identical in composition and properties. It is not necessarily the maximum temperature at which we can have equilibrium.

Suppose we have vapor at a high pressure and at temperature  $T_1$ . As we lower the pressure, keeping the temperature constant, the mixture goes into the two-phase region. In other words, part of the vapor will condense.

### Calculating for Ideal Solutions

It takes a lot of experimental work to measure two-component equilibrium. Sometimes we can cal-

culate it, and this is certainly a much simpler procedure.

For the ideal case, we can use Raoult's law for our calculations:

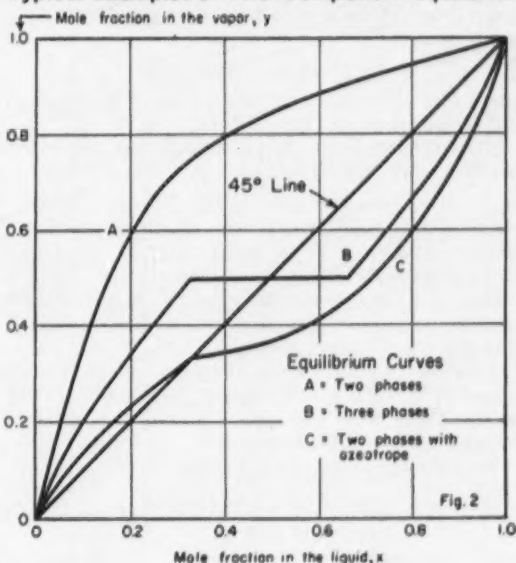
$$p_A = P_A x_A \quad (4)$$

where  $p_A$  is the partial pressure of component A;  $P_A$  is the vapor pressure of A;  $x_A$  is the mole fraction of A in the liquid; and all of these values are at some specified temperature.

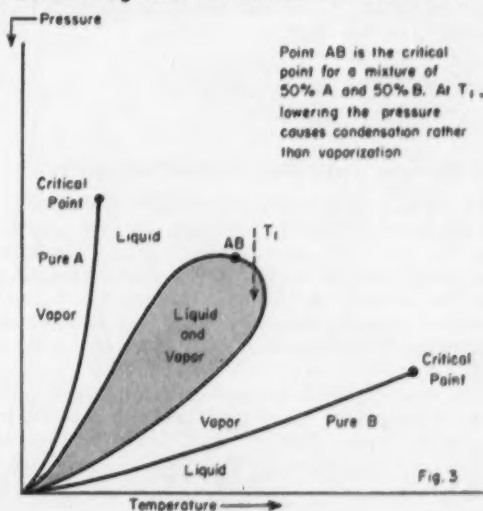
If we know this specified temperature, here's how to use Raoult's law:

First, calculate the partial pressure of each component using Eq. (4). Then add the partial pres-

### Typical Examples of Two-Component Equilibrium



### How Retrograde Condensation Can Start





tures to get the total pressure. The mole fraction of A in the vapor is calculated from the pressures, it is the ratio of the partial pressure of A to the total pressure:

$$y_A = p_A / (p_A + p_B) \quad (5)$$

On the other hand, we might know the pressure and want to find the temperature. In this case, we must first assume a temperature, calculate the pressure as described and repeat for different assumed temperatures until we check the correct pressure.

Let's use an example to see how this works.

### Sample Problem: Calculate Equilibrium

**Problem**—Assume that for substance A we have available a reliable equation that expresses its vapor pressure as a function of temperature. The equation is

$$\log P = 4.25 - (1,500/T)$$

where  $P$  is given in atmospheres; and  $T$  is the absolute temperature in °K.

Similarly, we have an expression for the vapor pressure of substance B:

$$\log P = 3.75 - (1,400/T)$$

Let the total pressure be 5.0 atm. and the liquid concentrations are given as 40 mole % of A and 60 mole % of B.

Find the absolute temperature,  $T$ , at which we'll have equilibrium; and find the concentration of A in the vapor at equilibrium.

**Solution**—As our method of solution, we'll assume values of  $T$ , calculate  $P_A$  and  $P_B$ ,  $p_A$  and  $p_B$ . Then we'll adjust  $T$  until the sum of  $p_A$  and  $p_B$  is equal to 5.0, or near enough to it.

We have tabulated our results below:

	$T = 400 \text{ K.}$	$T = 500 \text{ K.}$	$T = 441 \text{ K.}$
$P_A$	3.16	17.80	6.92
$P_B$	1.78	8.91	3.76
$p_A$	1.26	7.12	2.77
$p_B$	1.07	5.35	2.26
$\Sigma$	2.33	12.47	5.03

Once we have established the equilibrium temperature of 441 K., we can calculate the mole fraction of A in the vapor.

$$\begin{aligned} y_A &= p_A / (p_A + p_B) \\ &= 2.77 / 5.03 \\ y_A &= 0.55 \end{aligned}$$

### Use Relative Volatility for Convenience

There is a more convenient way to calculate the  $x$ - $y$  curve from data on pure components, provided that we can use a certain assumption. The more convenient method is the use of relative volatility and the certain assumption is that the relative volatility of two substances—over a small temperature range—is the ratio of their individual volatilities.

The volatility of component A in a mixture is the ratio of its partial vapor pressure to its mole fraction in the liquid phase:

$$\text{Volatility} = p_A / x_A = \gamma y_A / x_A$$

Then, the relative volatility of two substances is

the ratio of their volatilities:

$$\alpha = \left( \frac{y_A}{x_A} \right) \left( \frac{x_B}{y_B} \right) \quad (6)$$

If we are dealing with solutions that obey Raoult's law, we may use Eq. (4),

$$y_A / x_A = P_A$$

and

$$y_B / x_B = P_B$$

to obtain,

$$\alpha = P_A / P_B \quad (7)$$

When we calculate this ratio of vapor pressures for two substances. However, we find that this ratio is not a constant. It varies somewhat with temperature. Fortunately, we do find that the relative volatility is just about constant over a small temperature range.

If we assume that the relative volatility,  $\alpha$ , is a constant, we can derive an equation for the  $x$ - $y$  curve from Eq. (6). For two components,

$$\begin{aligned} y_B &= 1 - y_A \\ x_B &= 1 - x_A \end{aligned}$$

So that

$$\alpha = \left( \frac{y_A}{x_A} \right) \left( \frac{1 - x_A}{1 - y_A} \right)$$

Rearranging,

$$y_A = \frac{\alpha x_A}{1 + (\alpha - 1) x_A} \quad (8)$$

With Eq. (8) we can calculate the entire  $x$ - $y$  curve for simple mixtures. For a worked-out example of this procedure we refer you to a *Chemical Engineering Report* on "Binary Distillation" by Aaron Teller (*Chem Eng.*, Sept. 1954, p. 171).

### What About Nonideal Solutions?

Raoult's law works well for some solutions, but for most mixtures it doesn't hold. How can we handle these problems?

We can handle nonideal mixtures in one of two ways:

- Insert a correction factor in Raoult's law. Correlate this correction factor with the aid of thermodynamics. This correction factor is

$$\gamma_A = p_A / P_A x_A$$

and will be discussed in next month's installment.

- Forget about Raoult's law entirely and measure equilibrium vaporization ratios for each substance in the mixture. This ratio can then be correlated with temperature and pressure.

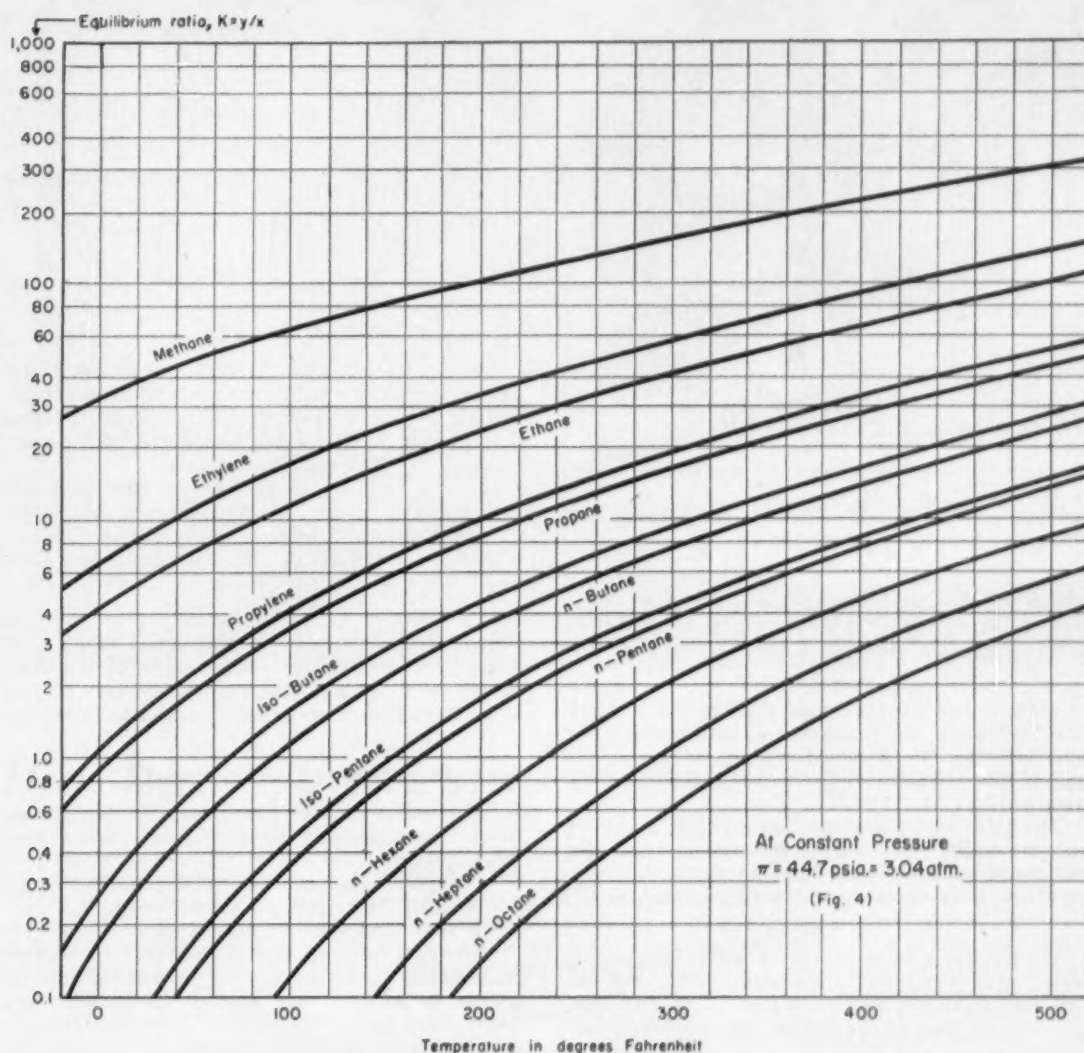
### How to Use the Equilibrium Ratio

Equilibrium vaporization ratios have been measured for many hydrocarbons, and are available in various literature sources. Perry's "Chemical Engineers' Handbook" presents a series of charts in the 3rd Ed., pp. 568-572.

The charts in Perry's handbook are for certain hydrocarbons ranging from methane to octane and show the value of the equilibrium ratio,  $K$ , as a



## For Hydrocarbons: You Can Predict Phase Equilibrium With This Chart



function of temperature. Each chart is specific for one value of pressure. At intermediate pressures, crossplots or interpolation are required.

We have reproduced one of these charts as Fig. 4 directly above. This chart is for a pressure of 44.7 psia, or 3.04 atm.

We can use the chart values for vapor-liquid equilibrium calculations with two or more components. Underlying the calculations is the assumption that the ratio for a given substance does not depend on what other materials are in the solution.

This is generally all right for hydrocarbons heavier than methane, and at pressures up to about 70% of the critical pressure.

Vaporization ratios are seldom used for materials other than hydrocarbons. This is because the ratios are not independent of the other component, and so we would have a different curve for each different

mixture. Such a situation is too unwieldy to be useful.

#### Calculating Phase Quantities

We can use the  $K$ -charts for equilibrium compositions and also for calculating relative amounts of vapor and liquid.

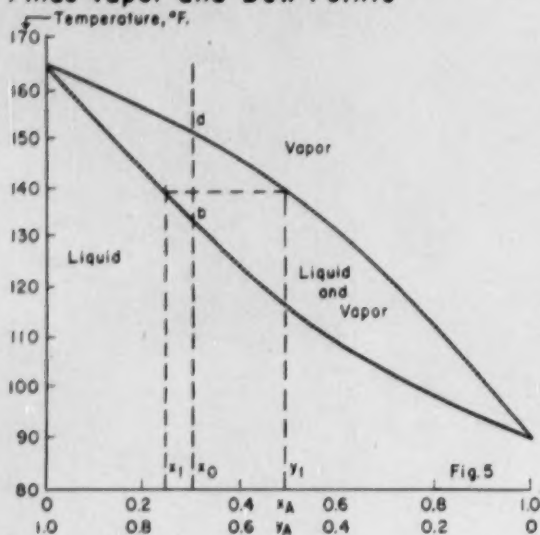
Frequently we need to know what happens to a liquid as it is heated. In particular we want to know:

- At what temperature does it start to vaporize?
- At what temperature does it start to condense?
- What is the proportion of vapor to liquid at some intermediate temperature?

Vaporization begins at a temperature we call the bubble point. Here the material is in the liquid



## Finds Vapor and Dew Points



phase and the liquid composition is the same as the over-all composition. We calculate the vapor composition with the aid of  $K$  values:

$$y_A = K_A x_A$$

We have to know the temperature to find  $K$ . Since we don't know the temperature, we'll assume one and then check the assumed value by adding  $y_A$  and  $y_B$ . If the temperature is correctly assumed, the sum will be unity.

The point where condensation starts is known as the dew point. Here all the material is vapor and the vapor composition is equal to the over-all composition. Now we calculate the liquid composition:

$$x_A = y_A / K_A$$

We assume a temperature as before and adjust until the sum of the  $x$  values equals unity. You can use this same procedure for more than two components, as long as the  $K$ 's do not depend on concentration.

For two-component systems we might do better by calculating the  $T$ - $x$  diagram, since we need a trial solution anyway. We choose various temperatures and for each we read  $K$ 's, then calculate  $x_A$  and  $y_A$ .

$$\begin{aligned} y_A/x_A &= K_A \\ (1 - y_A)/(1 - x_A) &= K_B \\ (1 - K_A x_A)/(1 - x_A) &= K_B \\ x_A &= (1 - K_B)/(K_A - K_B) \end{aligned}$$

After we have plotted the  $T$ - $x$  diagram, we can use it to calculate the proportion of vapor to liquid at a given temperature.

## Sample Problem: Vapor and Dew Points

**Problem**—A mixture contains 30 mole % of *n*-butane (*A*) and 70 mole % of *n*-pentane (*B*). The absolute pressure is 3.04 atm. Calculate the bubble point, the dew point and the fraction vaporized at 140 F.

**Solution**—Draw a plot of  $T$  vs.  $x_A$  and  $y_A$  using the

equilibrium constant and Fig. 4. This gives us Fig. 5. Our calculations are summarized below:

	Assumed Temperatures			
	90 F.	120 F.	140 F.	165 F.
$K_A$	1.0	1.6	2.0	2.6
$K_B$	0.30	0.50	0.66	1.0
$x_A$	1.0	0.45	0.25	0
$y_A$	1.0	0.73	0.50	0

Reading values from Fig. 5, we find that the bubble point is at 134 F.; the dew point is at 151 F.; and at 140 F, the fraction vaporized will be 20%, since

$$(x_0 - x_1)/(y_1 - x_1) = 0.20$$

## What to Do With Three Phases

When two components form immiscible liquid phases, and vapor is present, then there are three phases. There is one degree of freedom. Holding the pressure constant uses this degree of freedom, so the phase compositions are fixed.

If the substances *A* and *B* are completely immiscible, each exists pure in one phase and exerts its full vapor pressure at the existing temperature. The mole fraction of *A* in the vapor will be the vapor pressure of *A* divided by the total pressure

$$y_A = P_A/\pi$$

For other materials *C* and *D* which aren't completely immiscible, the compositions of all three phases—and the temperature—will be fixed as long as all three phases are present at constant pressure.

## What About Other Combinations?

It's possible to have four phases in equilibrium in a two-component system. These might conceivably be:

- Vapor, liquid and two solid phases.
- Vapor, two liquid phases and solid.
- Vapor and three liquid phases.

These combinations are very seldom seen, because in practical operation we try to make things as simple as possible. For any of the combinations listed there are zero degrees of freedom. There is only one set of conditions under which a combination can exist.

Solid-liquid phase equilibrium is useful in crystallization. Phase diagrams are very similar to vapor-liquid diagrams. We seldom deal with solid-vapor equilibrium. It is avoided wherever possible, because solids are more difficult to move than liquids.

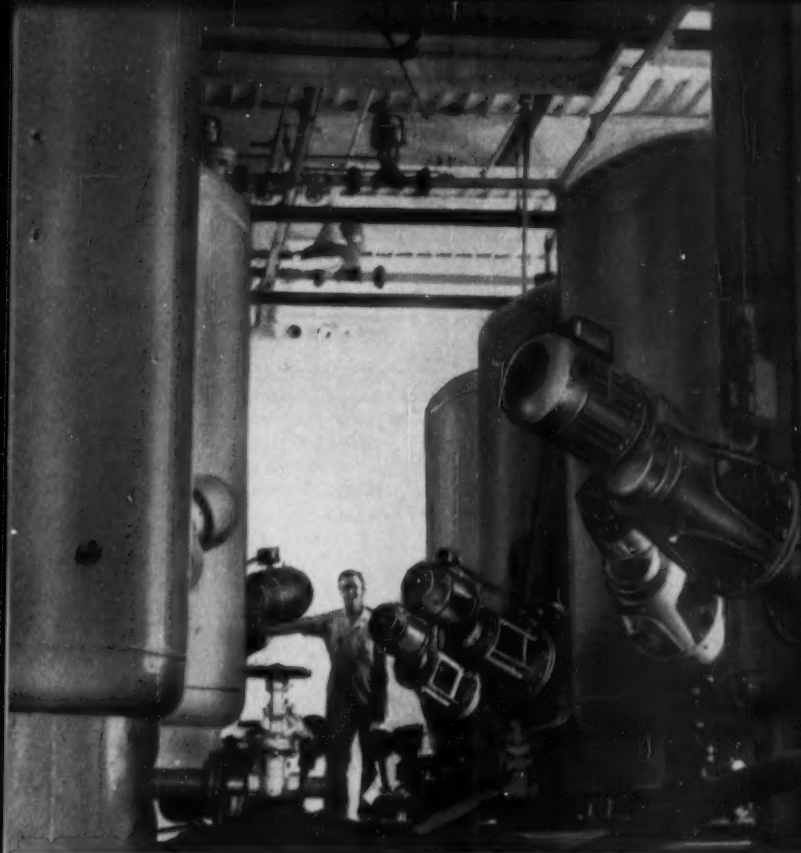
## Next Month: When Data Are Scarce

We rarely have all the data we want. Next month we'll discuss the problem of extending our data to get the most we possibly can out of them.

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Photo courtesy S. C. Johnson & Son, Inc., Racine, Wisconsin

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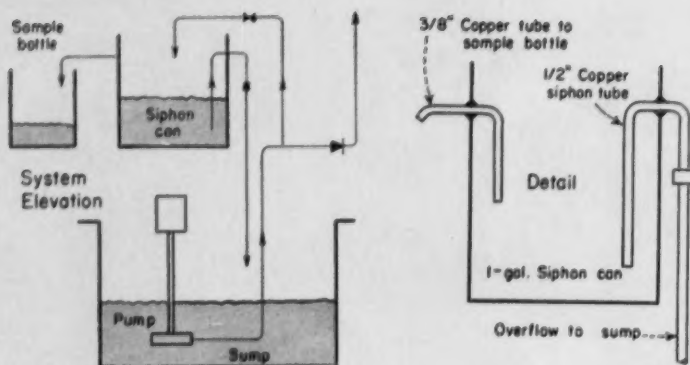
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## Plant Notebook

EDITED BY T. R. OLIVE



### ★ Winner of September Contest

## Sampler Handles Solids-Carrying Streams

When process streams contain suspended solids, most sampling methods fail. The trick here is to sample without any orifices that can plug.

E. F. LEONARD

Research & Development Dept., The Barrett Div., Allied Chemical & Dye Corp., Frankfort, Philadelphia, Pa.

Composite samples of process streams are commonly required in chemical plant operations. Normally, such samples can be obtained by collecting the small drip from a partially opened valve in the process line. This sampling technique fails, however, when solids or amorphous scum present in the stream block the valve opening.

The device illustrated above facilitates sampling of process streams that are heavily contaminated with solids. We use it to obtain composite samples of intermittent pumpings from a sump pump handling process wastes that have a very high scum and sludge content.

The sample stream is fed into a modified 1-gal. container. The rate of flow is approximately 1 gpm. which, in general, is the smallest rate at which flow is continuous. When the level of the horizontal section of the  $\frac{1}{2}$ -in. copper tube (see detail) is reached, the sample begins to flow through this tube into the collecting bottle. The interior bend in this tube is designed to

prevent skimming floating material from the surface.

Only a few drops will pass into the sample bottle before the level of the liquid in the container rises sufficiently to prime the siphon of  $\frac{1}{2}$ -in. copper tubing. The siphon discharges the con-

tents of the container back to the sump and the cycle starts again. The system operates smoothly without attention for several days and yields a compact, reliable composite sample of the process stream.

In some sampling devices which take a drip sample, the sample obtained would be biased in favor of portions of the collection period when flow rate was high, should partial blockage of flow from the process line occur. In the sampler described here, however, variations in the sample stream flow rate are compensated for by a corresponding change in sampling cycle time.

A decrease in flow rate causes the container to fill more slowly. But this allows flow to continue for a longer time through the  $\frac{1}{2}$ -in. sample line before the automatic siphon starts. Conversely, an increase in flow rate fills the container more rapidly, but decreases the period of sample-line flow before the siphon is primed.

The amount of sample collected per unit of time is, of course, the product of the number of cycles and the flow per cycle. Consequently, the sample obtained per unit of time does not depend strongly on the rate of flow from the process line.

The volume of sample collected is determined by the vertical

### ★ Winner of October Contest—Edward J. Gibbons

"Sky Hook" for Equipment Repairs

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Each month's winner will be announced in the issue of the second following month, and published the third following month.

**\$100 Annual Prize**—At the end of each year the monthly winners will be rejudged and the year's best winner awarded an additional \$100 prize.

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Articles may deal with plant or production "kinks," or novel means of presenting useful data, of interest to chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.



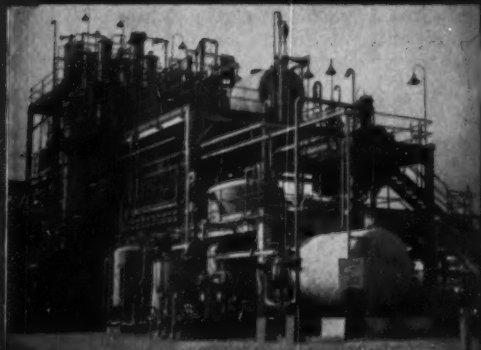
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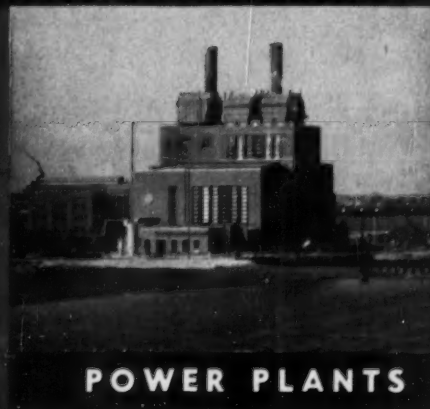
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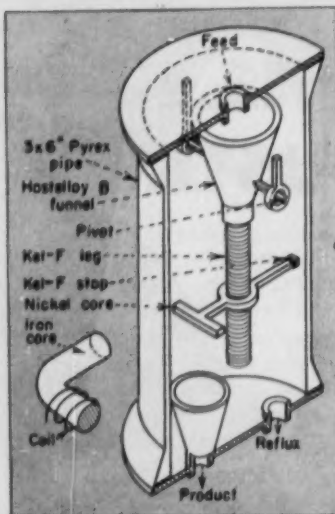
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distance between center lines of the  $\frac{1}{2}$ -in. siphon tube and the  $\frac{1}{2}$ -in. sample tube at the respective discharge points. It is therefore easy to regulate sample volume by changing this distance. It is merely necessary to bend the  $\frac{1}{2}$ -in. sample tube by hand to make the necessary adjustment and provide any desired sample volume over a specified period of time.

Once in a while it is necessary to remove accumulated sludge from the bottom of the can.



### New Reflux Splitter Resists Corrosion

L. T. Haire and S. R. Eckhaus

Respectively, Chief Mechanic and Chemical Engineer, Process Development Division, Directorate of Development, Chemical Warfare Labs, Army Chemical Center, Md.

A newly designed corrosion resistant flow splitter for plant or pilot plant use is sketched above. A swinging funnel is positioned by means of a magnet at low current requirements. This arrangement eliminates the need for stuffing boxes and any other direct linkages. The unique design permits using an electromagnet with very low current consumption.

The design shown has a Pyrex glass pipe and Hastelloy B, Kel-F, and nickel liquid flow splitter for use with distillation columns. The swinging funnel

splits the flow of liquid between reflux and product connections at any ratio desired, by the action of an electric timing mechanism which energizes the external coil. The funnel is normally balanced in the position for reflux flow. At intervals it is moved to the position for product flow by the pull of the magnet. The current requirement is approximately 0.5 amp at 6 v.

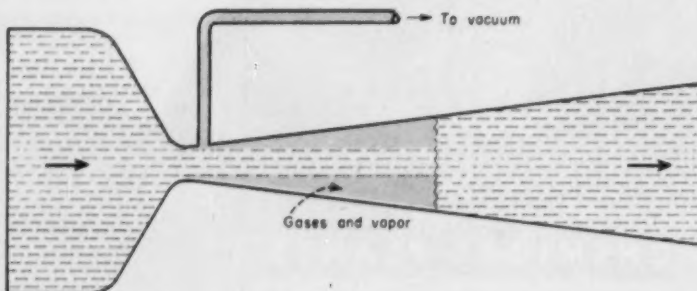
The important design feature is that the pivot is so located that the funnel acts as the counterbalance and actually aids the positioning when the small magnet puts the system out of balance. The 3-in. diam. x 6-in. Pyrex pipe makes the flow of liquid visible and permits the action of the funnel to be checked during operation.

Knife edges for the pivot help to reduce friction and lower the amperage, but are not essential. The threaded Kel-F tube below the funnel lightens the weight and also isolates the nickel core.

The funnel, funnel support, and top and bottom plates can be made of any construction materials required (i.e., stainless steel, Monel metal, Hastelloy, nickel, plastic, etc.). The Pyrex pipe is a standard item and does not require special fabrication.

An external electromagnet is shown, which acts on the nickel core through the Pyrex pipe. A glass- or plastic-coated iron core could also be used on the funnel leg. The iron core of the magnet used in this case was horseshoe-shaped, a  $\frac{1}{2}$ -in. diam. iron rod,  $1\frac{1}{2}$ -in. wide with  $1\frac{1}{2}$ -in. legs. The coil was made with 120 ft. of enamel-covered No. 24 magnet wire wrapped around the  $1\frac{1}{2}$ -in. width. The air gap was kept as short as possible.

This design has proven to be far superior to previously described magnetic flow splitters and requires no maintenance. The life of the coil at the low amperage used has been extended by a factor of at least 10.



### Cavitating Venturi Degassifies Liquids

B. S. Wright and S. D. Olieker

Respectively, Lt. (jg), U.S.N.R., U.S.S. Forrestal, and Engineer, Bendix Aviation Corp., Teterboro, N. J.

In our article on Cavitating Venturi for Flow Control, which appeared last month (*Chem. Eng.*, Nov. 1956, p. 221) we showed how a venturi could be operated so that the flow would be independent of variations in downstream pressure and hence could be used as a simple flow control device. When the venturi is operated so that the throat pressure equals the vapor pressure of the liquid passing through it, vaporization takes

place in the throat, causing a form of cavitation. The result is a core of liquid jetting through the throat, surrounded by a shroud of vapor.

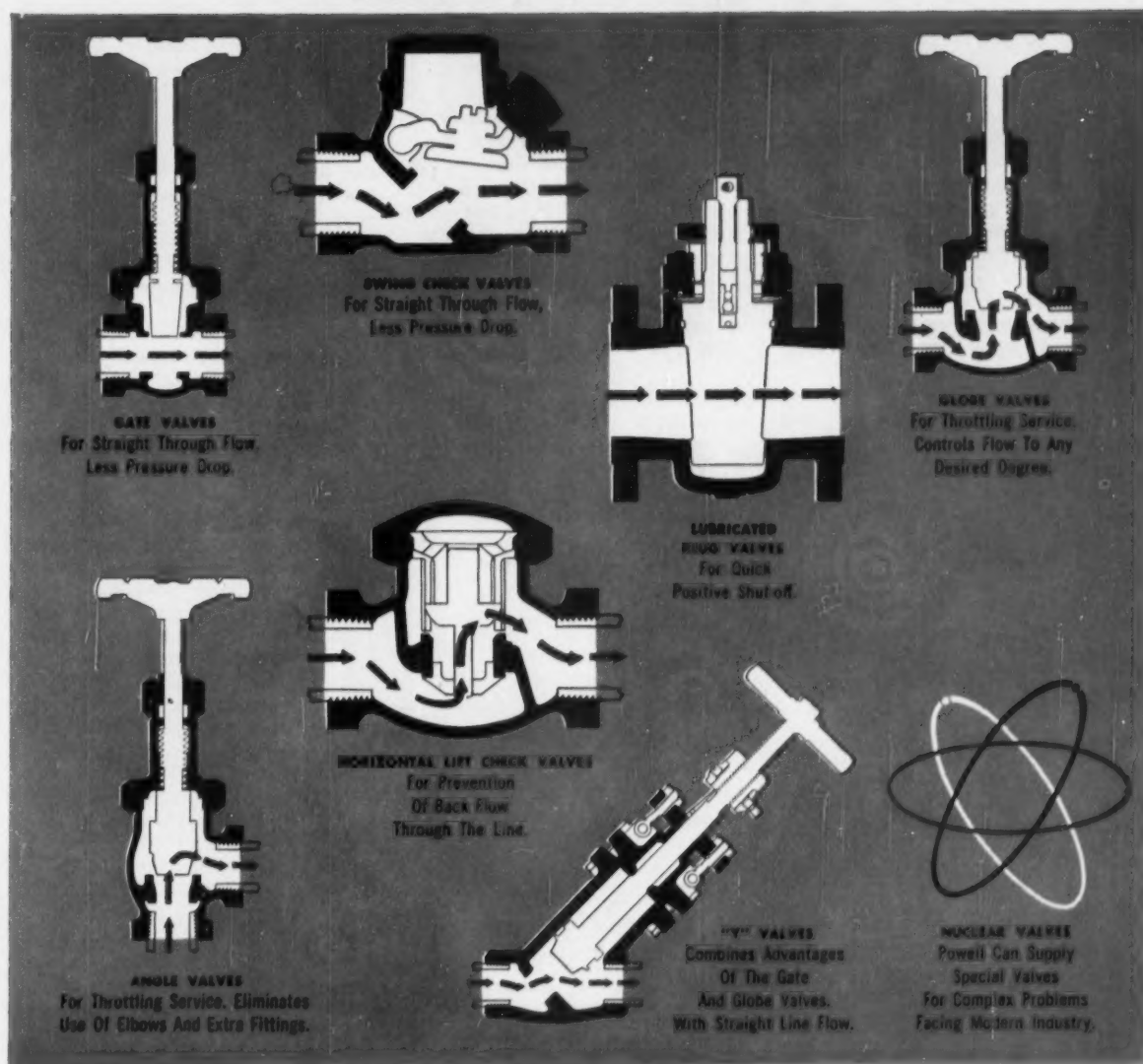
As the November article described, it is possible to calculate the relationships among the several parameters such that the venturi will cavitate and yet will condense the vapor so formed before it leaves the venturi diffuser.

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here. For complete information on the wide range of sizes and materials available in each type of the basic valves illustrated above, consult your Powell Valve distributor. If none is located near you—or if you have a special flow control problem—write direct to The Wm. Powell Company, Cincinnati 22, Ohio.



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flow-control characteristic, the cavitating venturi has another useful property which is described here. If the liquid contains dissolved and entrapped gases, they will come off with the vapor released by the cavitation. It is then a simple matter to draw off a part of the vapor from the throat by means of a vacuum pump, and thus remove the greater part of the gases as well. The method can be very useful for small-scale degassification operations.

To design a venturi for this application, determine the throat diameter such that the throat

pressure equals the vapor pressure of the liquid, using a modification of Eq. (1) in the November article:

$$D = 0.413 W^{1/2} / [(P - P_v) \rho]^{1/4}$$

Here  $D$  is throat diameter, ft.;  $W$  is the flow rate, lb./sec.;  $P$  is the venturi inlet pressure, lb./ft.<sup>2</sup>;  $P_v$  is the vapor pressure of the liquid, lb./ft.<sup>2</sup>; and  $\rho$  is the liquid density, lb./ft.<sup>3</sup>. The numerical coefficient contains the discharge coefficient of 0.93 which we have found to be suitable for cavitating venturis, rather than the usual venturi discharge coefficient of 0.99.

## Simple Test for Steam-Traced Pipe

R. G. Calkins

Engineering Dept., Research & Engineering Div., Monsanto Chemical Co., St. Louis, Mo.

In preparing for a recent plant start-up several lines of  $\frac{3}{4}$ , 1, 1 $\frac{1}{2}$  and 2-in. pipe size were steam traced with  $\frac{3}{4}$ -in. copper tubing to prevent the liquid handled from freezing at 80 C. The tracing was clamped at 12-18-in. intervals, was insulated with standard insulation over the pipes, and was heated with 90-100 psi. saturated steam.

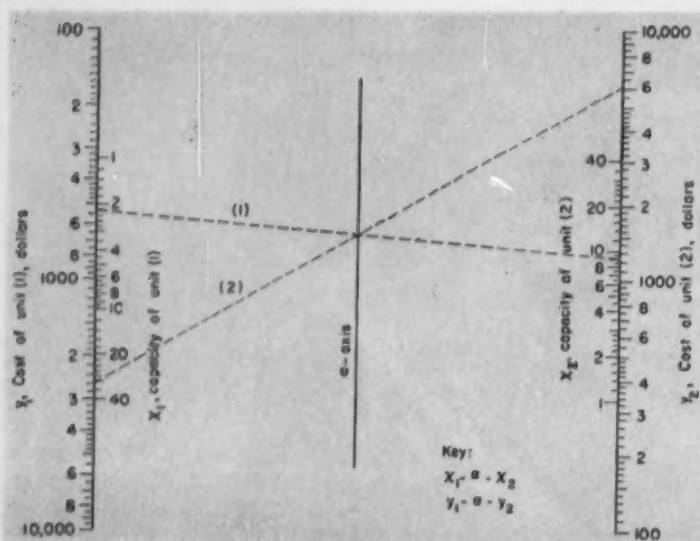
When the first batch of material was fed into the traced piping the entire system froze up, showing that insufficient heat was being conducted to the material in the pipes. At first it appeared that one or two additional tracers would have to be added to each line—a costly and time-consuming treatment. It seemed to me that without some method of evaluating the need for supplementary tracers, even the proposed addition might prove inadequate. Furthermore, it would be simpler and quicker to modify the existing tracing and insulation.

To test this out I procured a short section of 2-in. pipe with 90° ells at the ends for adding the test material and for measuring the temperature. We added tracing on the bottom side, clamped at 6-in. intervals and tamped lightly to insure intimate contact with the pipe. Ordinary grocery-store aluminum foil was wrapped around the pipe and tracing, and then insulation was added.

To make a test the test pipe was laid horizontal and filled with the solidified material. Saturated steam on the tracer tube melted all the solids in about 45 min. Steam was kept on until the maximum temperature of 110-115 C. was reached, well above the freezing point.

Several successful repetitions of the test were made after cooling and freezing.

After the scheme had been approved, several hundred feet of traced lines were revised. In a few days the plant was handling the high-freezing-point material without further difficulty.



## How to Estimate Equipment Cost

Dale S. Davis

Professor of Engineering, University of Alabama, Tuscaloosa, Ala.

Chemical engineers often need to estimate the cost of a piece of equipment for which reliable data are not available. In such instances they often make use of the expression  $y_2 = y_1 (x_2/x_1)^a$  as given by various writers, e.g., Williams (*Chem. Eng.*, Dec. 1947, p. 124). Here  $x$  represents capacity and  $y$  represents cost, while subscript 1 refers to a known, and subscript 2 to an unknown piece of equipment. Any units of capacity and cost apply.

The nomograph above readily solves this equation. For example, what will be the approximate cost of a 9-ton crusher if a 2.2-ton crusher of the same type costs \$2,600?

To get the answer, connect 2.2 on the  $x_1$  scale with 9 on the  $x_2$  scale and mark the intersection on the  $a$  axis. Connect this point with 2,600 on the  $y_1$  scale and continue the straight line to the intersection with the  $y_2$  scale at \$6,050.

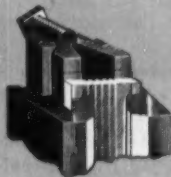


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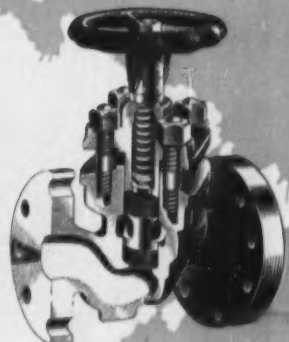
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The Klinger Valve consists basically of a finely ground piston, operated by the valve spindle and hand wheel, and moving through two or three non-metallic resilient valve rings, capable of resisting steam, oil and most fluids at high temperatures and pressures, and separated by a ported lantern bush. It has the following advantages:

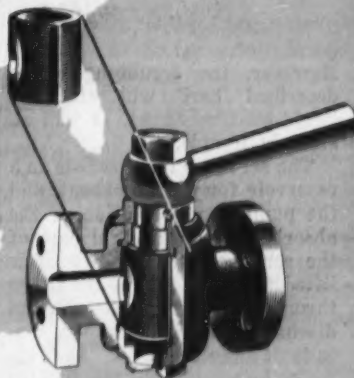
No seat—consequently no regrinding.  
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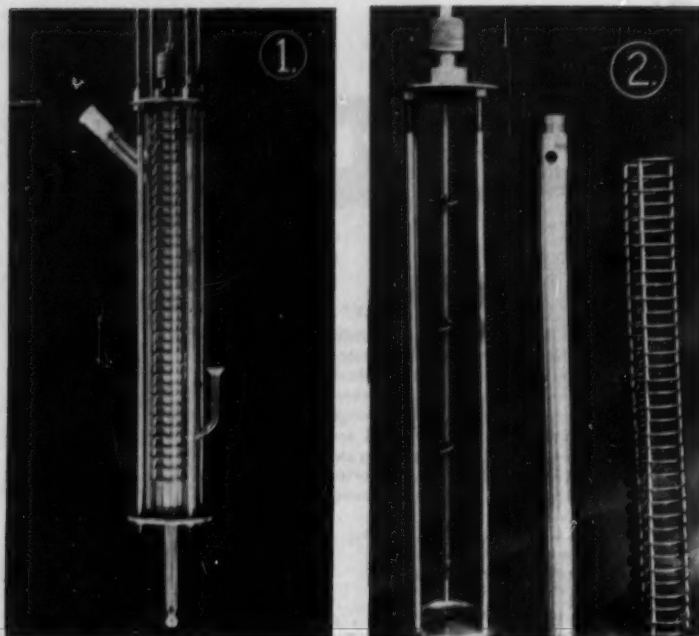
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## Cascade Scrubber Handles Suspensions

J. C. Driskell

*Division of Chemical Development, T.V.A., Wilson Dam, Ala.*

Most small laboratory and pilot-plant scrubbers will not handle suspensions or slurries. However, the scrubbing tower described here will circulate liquid-solid mixtures, as well as straight liquids.

The scrubber itself serves as a reservoir for the absorbent, and the pump for circulation of the absorbent is an integral part of the scrubber. The absorbent is lifted from the foot of the tower through a central draft tube and discharged radially onto a cascade of annular baffles. As it returns by gravity to the foot of the tower, the absorbent flows countercurrent to the rising stream of gas.

Fig. 1 shows the assembled unit and Fig. 2 the metal parts in greater detail. In this particular scrubber, the shell is borosilicate glass and the internal parts are AISI Type 316 stainless steel.

The draft tube (center of Fig. 2) is a 22-in. length of 1½-in. stainless steel pipe, machined to a uniform outside diameter of

1.812 in. Four ¼-in. holes near the upper end of the tube serve as discharge ports for the absorbent. The upper end of the tube is threaded into the upper end plate (left, Fig. 2). The tube is suspended with its lower end about ½ in. above the bottom of the shell to permit return of absorbent to the inside of the tube.

Across the lower end of the draft tube is a diamond-shaped bridge, supporting a bearing which centers the propeller shaft in the tube. The bearing is bushed with a rubber sleeve when abrasive solids are circulated in the scrubber.

The propeller shaft is a 5/16-in. rod machined at the ends to fit the foot bearing and the stuffing box on the upper end plate. The knurled stuffing nut has a fine thread for ready adjustment.

The screw propellers are pitched to give an updraft. Shaft and propellers are driven, through a flexible coupling, at 1,600 rpm. by a 1/30 hp. motor. The thrust is borne by a ball

bearing connected to the shaft immediately above the stuffing box.

The cascade (right, Fig. 2) comprises two sizes of baffle rings stacked alternately. These are cut from 0.0625-in. sheet and strung between ¼-in. spacers on three ¼-in. rods. The larger rings (2.02 in. I.D. by 2.70 in. O.D.) fit snugly against the shell of the tower and leave an opening around the draft tube, whereas the smaller rings (1.82 in. I.D. by 2.48 in. O.D.) fit snugly against the draft tube and leave an opening around the inside of the shell. This makes a zigzag path for flow of fluid through the scrubber.

The shell (Fig. 1) is fabricated from a piece of 75-mm. glass tube, handpicked from stock to fit the cascade. The flat bottom of the shell rests in a rubber-padded recess in the lower end plate. Absorbent is charged or withdrawn through the bottom by means of a central 15-mm. glass tube. Gas enters about 4 in. above the bottom of the shell, and leaves about 3 in. below the top. Both connections are glass. Top of the shell seals gastight against a rubber gasket on the upper end plate.

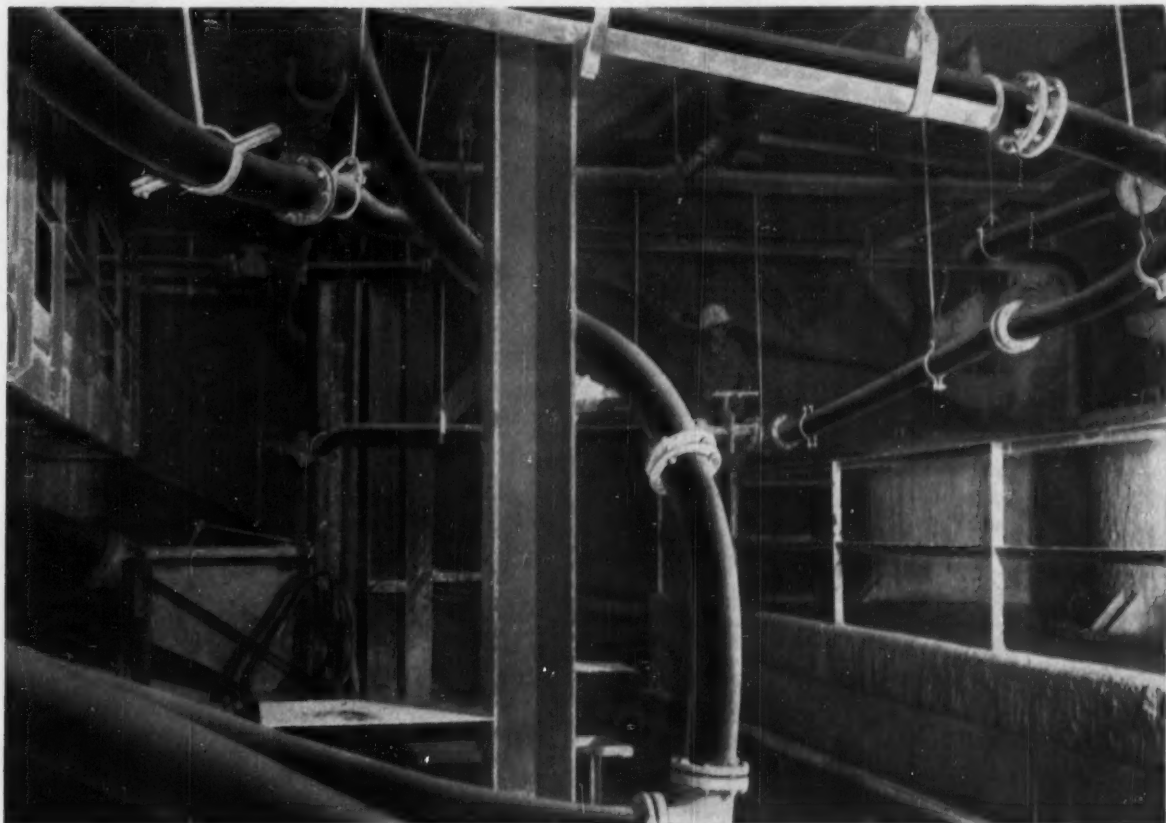
The two end plates with four ¼-in. tie rods constitute a supporting frame for the scrubber. Extensions on the tie rods support the motor (not shown).

The scrubber performed satisfactorily with little attention in a study that involved acidic gases and scrubbing liquors containing various suspended solids, including such abrasive minerals as pyrolusite and rock phosphate. It operated continuously for periods as long as a month. For much of this study, it was immersed in a constant-temperature water bath. A larger scrubber of the same design (2-in. draft tube 24 in. long and 100-mm. glass shell) gave equally satisfactory performance.

The only significant difficulty encountered was wear of the foot bearing when abrasive materials were circulated. Experimentation with bushing materials might prove worth while. Their respective properties suggest that Teflon, nylon, Tygon, and various rubbers would prove suitable for specific applications.



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## A production official of a phosphate chemical plant tells why he uses U. S. Pilot Flexible Pipe

"We change our production frequently, and the job is far simpler with U. S. Pilot® Flexible Pipe," continues the official. "This flexible hose can be strung anywhere it's needed. With metal pipes you have sharp corners. The flow tends to clog up at the first one, and then you've got a mess. But the gentle curving lines of U. S. Pilot Flexible Pipe make pumping simpler, and production better."

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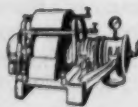
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## You and Your Job

EDITED BY H. T. SHARP

**Effective Communication on the Job**, edited by M. Joseph Dooher and Vivienne Marquis  
**Management in Action**, by Lawrence A. Appley  
**Successful Executive Action**, by Edward C. Schleh  
**Executives: Making Them Click**, by Joseph Dean Edwards  
**Chemical Market Research in Practice**, edited by Richard E. Chaddock  
**Common Sense in Research and Development Management**, by George W. Howard  
**Coordination, Control and Financing of Industrial Research**, edited by A. H. Rubenstein

## These New Books Can Help You Get Ahead

**This year, the management-minded chemical engineer can find plenty of books that'll give his career a shove in the right direction. Here are some of the best.**

According to the latest annual report of the American Management Assn., the United States now faces the greatest shortage of trained management personnel that it has ever experienced.

Further, AMA predicts that "the industrial and business expansion of the past ten years is minor compared with what is ahead of us and, despite a noticeable increase in the number and capabilities of managers, prospects for the future do not indicate that that increase will keep pace with economic expansion."

### **Making Yourself Ready**

Assuming AMA really has its finger on the management situation—and it invariably does—this prediction should be encouraging to every chemical engineer who wants to move up the management ladder. Opportunities will be there, all he has to do is prepare for them.

Keeping up with the best in management and business literature is one of the best ways of preparing for these opportunities.

Such reading puts you in contact with new ideas and techniques and, by giving you a share in the experiences of others, helps you view your own thoughts, work methods and job experiences in better perspective. To start with, this new perspective will probably help you do your present job better—and that's the first step in preparing for future posts. It will also give you an insight into what goes on—or at least what should go on—at higher management levels.

### **Communication Keys Progress**

For example, one of the most important skills in the effective manager's repertoire is his ability to communicate. In fact, communication is much more than a skill, it's the way management gets its job done. Good managers are always good communicators. It's as simple as that.

You'll get a better appreciation of the ins and outs of this vital aspect of administration from the essays you'll find in **Effective Communication on the**

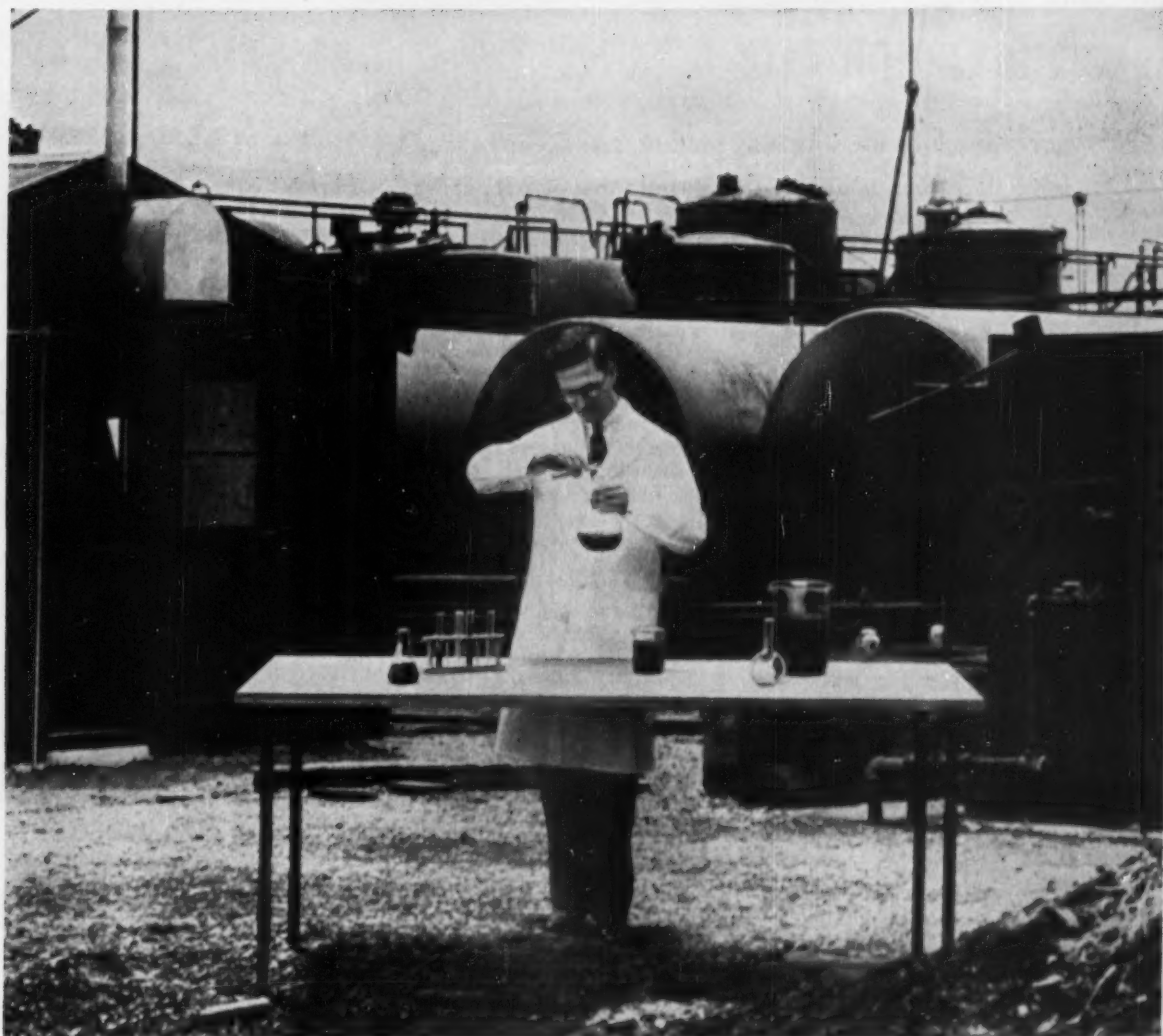
**Job** (Edited by M. Joseph Dooher and Vivienne Marquis, American Management Assn., New York, 1956, \$4.). The almost-thirty chapters in this slim volume will take you from the basics of effective communication through interviewing and conference leading to speech making.

Many of these chapters have appeared in past issues of AMA's magazine *Personnel*. But the editors have inserted a few well-chosen additions and skillfully and logically woven an excellent guide for both employer and employee.

Naturally, a compilation such as this isn't as smooth reading as a book by a single author might be. There's a certain unevenness of style and a wordiness in some sections (especially the early ones) that would have justified tighter editing. But the quality of the essays is generally high and the advantages of having outstanding experts expound their specialty makes for much exciting reading.

Especially good are Lydia Strong's discussion of how to be a good listener; the treatment William Exton, Jr., and Stuart Chase prescribe for curing semantic difficulties in communication and a string of essays on interviewing techniques.





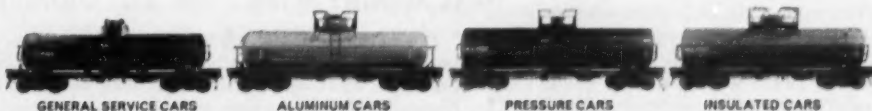
## What's a chemist got to do with tank cars?

Liquid level—vapor action—types of linings—temperature factors—the presence of impurities . . . these are a few of the considerations which the chemist must evaluate. It's the chemist's job to see that bulk liquids are shipped in the cars equipped to carry his products. The knowledge gained from years of hauling liquids in bulk enables General American to meet the chemist's exacting requirements—to assure that corrosion of the cars will be minimized and product contamination prevented.

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**Try These Techniques**

For instance, do you know how to insure high-quality listening under stress? Next time you're in an argument, insert this rule into the discussion: *Each person must briefly state the ideas and feelings of the prior speaker before launching into his own side of the subject. The prior speaker, of course, has the privilege of correcting any distortions at once.*

This forces all sides to really open their ears and to understand each other. More often than not it dissipates much of the heat of the discussion and makes differences easier to reconcile. It makes a handy tool for home or job.

Another handy technique: Do you know how to ask a question so that it avoids a plain "yes" or "no" answer? Start your question with *Who, What, Where, When, Why* or *How*, not *Do* or *Did*.

No matter what your job level, you'll find lots of practical help and guidance here. It belongs in the reading program of any advancement-conscious engineer. And the many chemical industry examples the authors use bring its lessons home to chemical engineers particularly.

**Getting Things Done**

Another AMA compilation that can help you prepare for those opportunities ahead is Lawrence A. Appley's **Management in Action** (American Management Assn., New York, 1956, \$5.). Subtitled "The Art of Getting Things Done Through People," this work includes selections from Mr. Appley's monthly column in AMA's *Management News* as well as a few articles from other AMA publications.

President of AMA for the past eight years and guiding spirit of its extremely successful Management Course (see *Chem. Eng.*, Dec. 1953, p. 258), Larry Appley is one of the world's foremost students and shapers of manage-

ment thought. His inside-out knowledge of his material and deftness in writing show clearly on every page. However the reader will wish that Mr. Appley had not simply grouped his selections, since a slight rewriting to provide bridges between the unusually short chapters (most are only three pages long) would make for easier reading.

**Read and Think**

Perhaps the best way to read this book would be one chapter a day. Five minutes of reading and 55 minutes spent thinking about what you've read would make better managers—and wiser men—of most of us.

Much of the time Appley's on a philosophical level, but don't let that scare you away. He packs a lot of practical know-how between these covers as well. And the philosophical stuff won't hurt you.

An important part of the art of getting things done through people is proper discipline. Appley's brief discussion of this problem is almost a sermonette complete with text, lesson and a plea for action. But it is pregnant with ideas for thoughtful men to consider and practical men to use.

**Cuts Away the Crust**

One of the longer chapters (11 pages) is aptly titled "Management the Simple Way." In it, Appley cuts through much of the mumbo-jumbo that you find in some books on management and gives a few simple and lucid thoughts, which, if you keep them in mind, will squeeze a lot

of waste motion out of your managing.

Typical of the "practical" advice you'll find is the section of tools and techniques of management. Here's help on organization planning, cost reduction, making and using a budget and other posers.

Appley himself has no illusions about managers—or would-be managers for that matter—solving their problems by reading a book—even his book—and he says so. But after looking at "Management in Action" through his experienced eyes, you'll probably see your management problems more clearly defined.

And what is it they say? "A problem well defined is 90% solved."

**Learning by the Numbers**

Along similar lines, management consultant Edward C. Schleh explores **Successful Executive Action** (Prentice-Hall, Englewood Cliffs, N. J., 1955, \$10.).

This is more of a "how-to" book than the Appley work. Concerned almost wholly with doing the day-to-day job more effectively, Schleh relies rather heavily on the Army method of instructing "by the numbers."

You'll learn *four* benefits arising from farsighted controls, *four* dangers of controls, and *four* errors of committees along with *three* causes of failure of committee operation.

*Seven* techniques that get results for people are backed up by *five* ways to check on whether you need staff and *seven* misconceptions about accountability. You'll also find *eight* ways to build reliance on your men, *four* ways to give that extra push and *four* don'ts in stimulating men.

In his preface, Schleh says that his book was written to give

**Next Month: What's the Job Outlook for 1957?**

If you find yourself job hunting in the next twelve months, will you be in for a fairly easy time of it or will you really have to scrounge around? What will the salary outlook be? Do you know of the latest trends in job-hunting that will affect your search? You'll get a preview glimpse of the outlook for each age group and work group, a peek at the salary situation and a chance to scrutinize the other important factors that'll make '57 a good or bad year to switch jobs, all in January's *You & Your Job*.



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8-419



"Five minutes of good reading and 55 minutes of thinking about it each day would make better managers—and wiser men—of most of us."

the executive a series of principles tied over by illustration into actual practice. He's succeeded in doing just that.

Few authors try as hard to help their readers as Schleh does. Set in big, easy-to-read type, the text is literally saturated with references to other works, more detailed treatments of specific points. Each chapter ends with a set of questions designed to stimulate the thinking of the reader and to guide him in applying what he's just learned.

#### Ignore These Errors

Schleh's at his best when he's discussing the "rule of errors," how to apply controls and how to get results from committees.

For what errors should you call a subordinate to account? The rule of errors says that he's accountable for over-all results and the over-all cost in loss and expense in arriving at it. He shouldn't be called on the carpet or badgered for smaller errors he might make in specific decisions while doing a successful over-all job.

With appropriate illustrations, Schleh explores the implications of this rule and its application to specific instances. It should be studied and applied by every manager who wants to do a better job—and who sincerely wants his men to do better jobs—and be more content on the job.

Good reading for the man on his way up, this book deserves close study by those now in management posts.

#### For Those Who've Arrived

For those who now hold high-level executive posts and who now worry about developing the men at lower rungs on the management ladder, a few evenings with Joseph Dean Edwards' *Executives: Making them Click* (University Books, New York, 1956, \$4.) will pay handsome dividends.

Subtitled "A Successful Plan to Replace So-Called Executive

Development Programs," this is essentially a primer on how to tailor-make a good executive. An attorney and industrial consultant, Edwards delights in pointing out that a good many men are becoming first-rank executives *despite* the existence of an executive development program in their company.

His book is primarily concerned with what's needed to promote and stimulate executive growth. The proper climate for maximum growth is not readily achieved in most firms. But it's Mr. Edwards' belief that firms can and should strive toward this goal and he details specific recommendations that will help attain it.

#### Lower Stress, Greater Pull

After analyzing every reason for an executive's success or failure, the author makes concise suggestions for reducing the pressures and strains that lead to failure and for increasing the pull toward successful development.

Edwards covers the broad field of executive development with specific discussions of its most important aspects. How should you measure an executive's success? How can you handle the appraisal interview best? Why shouldn't you keep a file of appraisal reports? These and similar specific questions are asked and answered.

The book winds up with a section of charts and other exhibits which can serve as tools for cultivating executives. There's also a list of school and college courses which will prove useful in helping a man develop managerial talents.

Though written primarily for men who've already attained high-ranking posts, Edwards' book can help mark career guideposts for ambitious junior executives.

#### To Get a Broader View

Now, to reverse our field, here's a book that'll be most

helpful to younger chemical engineers, particularly those who feel they need a broader view of the chemical business than their daily job and related reading provide.

**Chemical Market Research in Practice** (Reinhold Publishing Corp., New York, 1956, \$3.) can help them acquire such a view.

Based on a series of lectures presented at Case Institute of Technology and at the University of Delaware's Extension Division by twenty-two members of the Chemical Market Research Assn., and edited by Hercules Powder's Richard E. Chaddock, these 16 chapters cover the whole field of market research in the chemical industry and present numerous case histories to illustrate the techniques used.

For the present or potential market researcher this little book is a must. Numerous bibliographies and other helps will make the job of the present MR a little easier. But he may find much of the text a bit oversimplified. On the other hand, this feature puts it right down the alley of the potential, or the inexperienced, MR.

#### Not Just for the MR

Even if you have little interest in market research as a career, you can still learn a lot from this book. It will give you a better understanding of the business end of your industry.

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After four years of steady service, these lines look and operate like new. They are free of corrosion and erosion.

Cost figures over the four-year period still indicate that PYREX pipe is the most economical installation for this exposure. At Thiokol, maintenance is very simple and cost is reasonable.

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In this process, paraformaldehyde occasionally builds up. This could be a real threat in any opaque pipe but it's visible in glass. As soon as it collects, Thiokol flushes it out with steam.

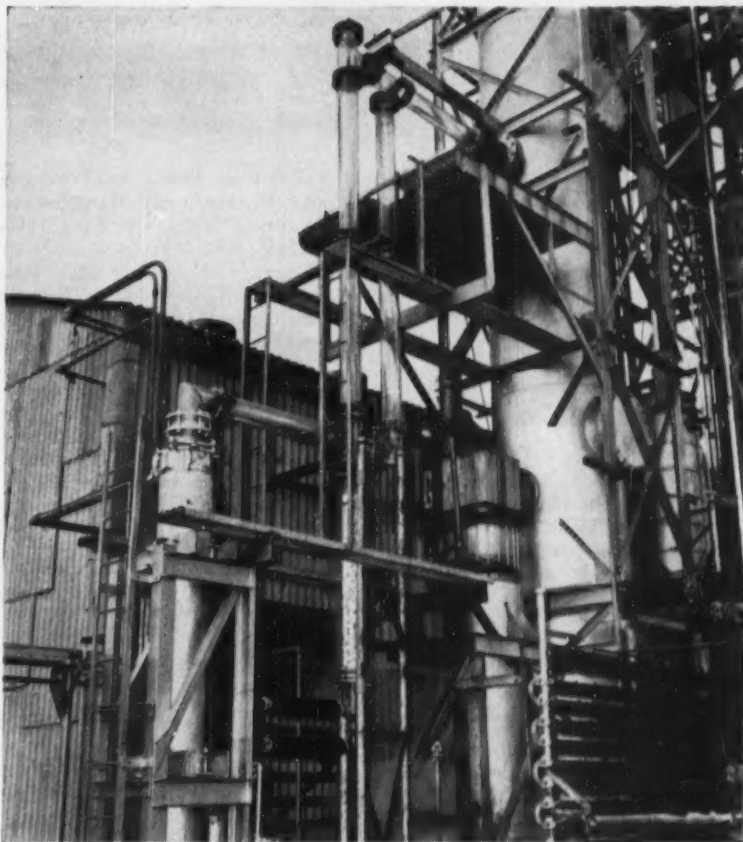
Easy cleaning is a prime characteristic of PYREX pipe. Suppose you want to use the same lines for incompatible fluids. You clean glass lines at change-over time simply by flushing them with low pressure steam, hot water, detergent solution, or, in some cases, with dilute HCl. No down time, no difficulties. And you see when lines are clean.

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The men who regularly install your piping can install glass pipe easily, even if they've never worked with it before. Thiokol's own men cut and assemble PYREX brand pipe. The field kit makes this an easy job.

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No matter what corrosives you transport, except HF and hot concen-



Four years of hot chlorinated hydrocarbons and strong solutions of HCl and water and pump vibration . . . yet these glass lines operate today as well as they did when new.

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**"A better over-all view of your industry will almost surely make you more promotable. Here's one step on your way to acquiring such a view."**

You'll better appreciate why some of your ideas and suggestions were passed over by management. And you'll be in a better position to offer acceptable ideas.

A better over-all view of your industry will almost surely make you more promotable. Here's one step on your way to acquiring such a view.

#### These Can Help Too

Switching from market research to chemical research, two new books will help you get a better perspective on the management of this important activity.

**Common Sense in Research and Development Management** (Vantage Press, New York, 1956, \$2.75) resulted from a tour of over 80 first rate R&D labs in the U.S., Canada and Europe by George W. Howard, research engineer at the government's Fort Belvoir, Va., lab.

An astute observer, Mr. Howard has recorded what he likes and dislikes in the management practices of these installations. To further help research managers, he's appended an evaluation questionnaire and included an extensive bibliography on research and development management.

**Coordination, Control and Financing of Industrial Research** (King's Crown Press, New York, 1955, \$8.50) presents the proceedings of the Fifth Annual Conference on Industrial Research, 1954, and includes a few selections from the Fourth Conference, 1953. Both conferences were sponsored by Columbia University's Industrial Engineering Dept.

Edited by Albert H. Rubenstein, this book is concerned with the link between research and financial management. It tells how the objectives, scope, budgeting, control and appraisal of company research are, or should be, related to the financial resources of the organization.

Both research management and general management men can profit from the advice they'll find here.

## RETIRED ENGINEERS

### . . . For Teaching Jobs

The suggestion that retired engineers and scientists be allowed to teach part time in the high schools to augment the thin ranks of science and math teachers isn't a new one, but it is now about to be translated into action.

Sparked by Joseph W. Barker, president of ASME, this proposal is now being actively considered in many parts of the nation. In New York City nearly 60 individuals responded to an invitation to register their willingness to teach with the school system's supervisor of science.

One hitch in the use of these men is a legal requirement for teacher licensing. Currently, the state requires an applicant to have completed a minimum of eight semester hours in professional education courses. Few scientists or engineers can meet this regulation.

But if the background of their part-time-science-teacher applicants is satisfactory in all other respect, city school officials plan to ask the state to modify the regulation for the duration of the present emergency.

In Colorado, Governor E. C.

Johnson will ask the state board of education to consider the same type of plan. And school administrators in other sections of the country are said to be considering the step.

Many administrators say that one of the drawbacks of the plan is a lack of retired men who are qualified for and interested in teaching at the high school level. They tell us they'd have to have a display of interest by potential teachers before they could ask for waiver of any licensing requirements. If you're interested, you should make yourself known to the superintendent of your local school system.

## TEN-DAY COURSE

### . . . For All Levels

Designed to be of value to all levels of engineering and management personnel, a ten-day engineering and management course will be given on the Los Angeles campus of the University of California on Jan. 21-31.

Lectures will cover general management principles, engineering and research administration, managerial adjustment to labor law and union relations,

leadership principles, the economics of plant investment and equipment replacement. There will also be a laboratory in leadership and specialized work in motion study, work simplification, work measurements and allied topics.

Information about course materials and registration details is available from Edward P. Coleman, Engineering Extension, Room 3104, University of California, Los Angeles 24, Calif.

## HELP AVAILABLE

### . . . For Those in Service

Chemical engineers now in service who have been assigned to duties without regard for their specialized training should get in touch with the Engineering Manpower Commission of the Engineers' Joint Council.

In recent months EMC has helped over 100 drafted engineers obtain a reassignment which uses their talents more fully. This works to the benefit of both the men and the armed forces.

If you're interested, write to W. T. Cavanaugh, Engineers' Joint Council, 29 West 39th St., New York 18, N. Y.





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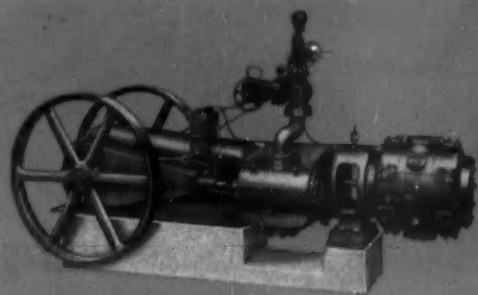


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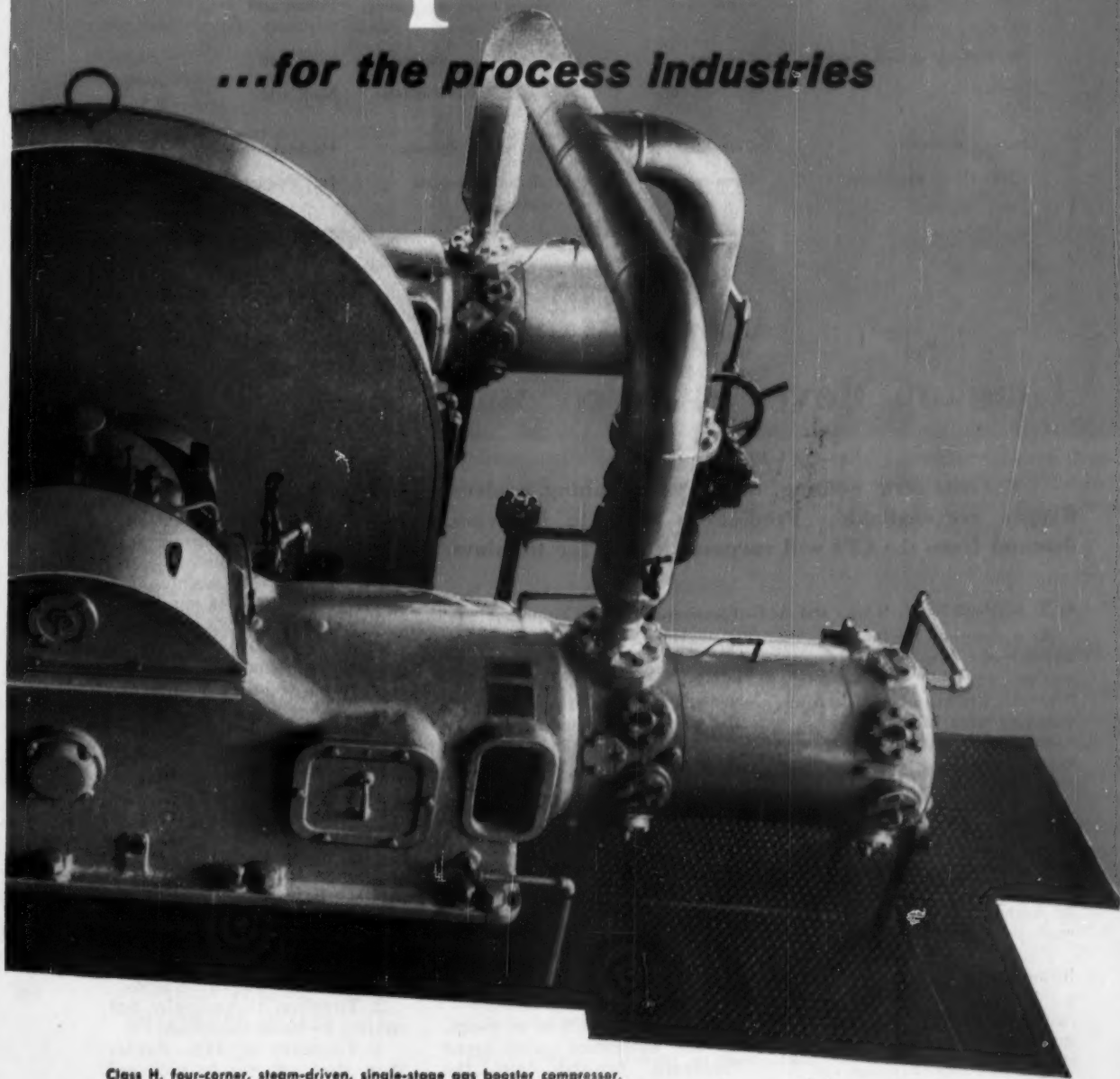




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## Corrosion Forum

EDITED BY R. B. NORDEN

### Box Score on Titanium in the Chemical Process Industries

Titanium Equipment	In These Industries	In These Processes	Resisting
Presses, screens	Chemical	Manufacture of commercial bleach	Calcium hypochlorite
Drums, dryers, heat exchangers	Chemical	Manufacture of commercial bleach	Sodium hypochlorite
Mixers, screens, nozzles, baffles	Pulp & Paper	Bleaching paper pulp	Chlorine dioxide
Autoclaves, impellers, valves	Extractive metallurgy	Cobalt and nickel recovery	Sulfuric acid
Racks, contact tips	Metal	Aluminum anodizing, plating, electropolishing	Sulfuric acid
Heat exchangers, coils, reactors	Chemical	Manufacture of explosives	Nitric acid
Reactors	Pharmaceutical	Manufacture of organic intermediates	Nitric acid
Steam jet diffusers	Chemical	Manufacture of pigments	Hydrochloric acid
Impellers, heat exchangers	Chemical	Manufacture of organic chlorides	Free chlorine
Packs	Metal	Metal etching	Ferric chloride

## Titanium Moves Into Process Equipment

**Costs are coming down, and tubing, valves, flanges, are available. Prediction: In 5 to 10 years, demand from the CPI will surpass aircraft for titanium.**

G. T. Bedford, W. J. Weeks and A. G. Caterson, Rem-Cru Titanium\*

As a chemical engineer keenly aware of new developments, you've probably followed the dramatic growth of the titanium industry with interest.

You've watched as a laboratory curiosity became an engineering metal. You've critically examined the early, perhaps over optimistic claims. And you have followed the discussions and reappraisals as the new industry faced up to the challenge of tonnage production and the realities of shop practice.

Finally, you've observed with interest that titanium had made a "technological breakthrough," and demand for the light, strong metal was skyrocketing in the

aircraft and jet-engine industry. All of this may have been dismissed as interesting enough—but of vital importance only to the aircraft engineer.

Yet, the chemical engineer may be surprised to learn that sober citizens who have followed the development of titanium with a sharp pencil and a realistic eye for the dollar sign, agree to the following two propositions:

• At today's price (less than \$8-\$15/lb. finished mill product) many applications exist in the chemical process industry where titanium is the most economical material of construction.

• In the next 5 to 10 years, as the downward price trend continues, demand from the

chemical process field and allied industries will equal if not surpass the demand of the aircraft industry.

These two statements are based primarily—but not exclusively—on titanium's corrosion resistance, which excels copper-base alloys, aluminum, stainless steels and special purpose alloys in a wide variety of applications.

While certainly not the "perfect" metal, titanium offers many advantages over popular metals of construction used by the chemical industry today:

1. Titanium possesses distinctly better corrosion resistance than common engineering metals in sea water, moist chlorine, metallic chlorides, bleaching solutions and under certain conditions, in nitric, hydrochloric and sulphuric acids.

2. Titanium is generally not subject to stress corrosion.

3. Titanium is 44% lighter than steel, yet can be produced

\*Meet your authors on page 408.





CHEMICAL ENGINEERING  
PROPERTY AND APPLICATION DATA  
ON THIS VERSATILE ENGINEERING MATERIAL

# NEWS

## Bearing buttons of **TEFLON**® eliminate lubrication in valve handling corrosive fluids

Bearing buttons of **TEFLON** tetrafluoroethylene resin make this unplasticized polyvinyl chloride plug valve, used in piping corrosive fluids, permanently "self-lubricating". The exceptionally low coefficient of friction of **TEFLON** ( $f = .04$ ) assures ease of turning, and prevents seizing and galling.

The buttons are designed as inserts in the valve spindle. In the closed position, the buttons provide a chemically inert block across the open diameter of the pipe. A seal of **TEFLON** is used on the valve shaft to prevent external leakage.

This valve has been operating for more than a year in concentrated HCl at room temperature. The user reports that no problems of corrosion, sticking or lubrication have occurred at any time so far.

**TEFLON** resists all chemicals normally encountered in industry. Exceptions to this are metallic alkali metals, under certain conditions. At elevated temperatures and pressures, halogens and certain halogenated chemicals and solvents may affect **TEFLON**.

DuPont **TEFLON** remains tough through a wide range of temperatures. It has no water absorption. Sticky or viscous materials do not adhere to its waxy surface. **TEFLON** is specified for electrical uses be-



Vital components of DuPont **TEFLON** (shown in red) are utilized in this polyvinyl chloride plug valve (patent pending) manufactured by Tube Turns Plas-

tics, Inc., Louisville, Kentucky. Shown above is an exploded view of the valve based on a transparent mock-up made of DuPont **LUCITE**® acrylic resin.

cause of its high dielectric strength and extremely low power factor. The combination of these properties gives **TEFLON** unique advantages in a broad range of applications.

It will pay you to investigate the many possible uses for DuPont **TEFLON**. For data on this outstanding engineering material, available to you without cost or obligation, clip and mail the coupon below.

### **TEFLON**®

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**TEFLON** is the registered trademark for DuPont tetrafluoroethylene resin, and should not be used as an adjective to describe any other product or any component part; nor may this registered trademark be used in whole, or in part, as a trade name for any product.

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For basic data on the properties and applications of DuPont **TEFLON**, mail the coupon.

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Comparing Costs of Stainless and Ti—Table I

	AISI Type 316 Stainless Steel	70-95,000 Psi. Titanium	Cost Factor
Price per lb., 0.0625 sheet, 1,000 lb. quantity	\$0.8325	\$14.10 (13.35 mill size)	17
Adjusting to price per sheet	Density, 0.286 lb./ cu. in.	Density, 0.163 lb./ cu. in. (35.4 lb./sheet)	9.5
Assuming material costs are 20% of finished assembly in stainless	Materials = x Fabricating = 4x Finished assembly = 5x	Materials = 9.5x Fabricating = 4x Finished assembly = 13.5x	Less than 3

in the same strength ranges. This has obvious advantages for transportation equipment and mobile handling equipment used by the chemical process industries.

Also, titanium is now manufactured on a routine production basis in all standard mill product forms. Forming, welding and machining techniques are rapidly becoming well established.

#### Economics of Titanium

Titanium in equipment, used where its corrosion resistance is distinctly better than other engineering metals, can often pay for itself on the basis of replacement costs alone.

This may seem surprising in view of the high price per pound of titanium mill products. To take a specific example, one grade of titanium sheet in standard size and 1,000 lb. quantities sells for \$14.10/lb. Compared to AISI type 316 stainless steel,

the per pound price is 17 times greater.

However, titanium weighs only 56% as much as steel, so that less material is required. Compared on the basis of per sheet or per square foot, the cost factor becomes 9.5 times as great.

However, the next step in a comparative cost analysis would be to compare, not the cost of raw materials, but the cost of a finished assembly. Fabrication often accounts for the lion's share of a finished assembly, and since there should be little if any greater fabrication cost for titanium than stainless, the cost factor is reduced to two to five times (see Table I).

Actually price comparisons (made before the latest titanium price reduction) on racks, coils, reactors, autoclaves and heat exchangers substantiate these comparative cost figures. That is, a reactor in titanium would cost

between two and five times the same equipment in stainless steel.

Whether the proper cost factor will be two or five will depend on the following:

- Amount of fabricating required.
- Production experience with similar units in titanium.
- Particular design of the equipment.

This cost analysis has been made only on the basis of materials and longer service life. It does not take into consideration the savings through reduced maintenance or elimination of downtime. These factors can tip scales in favor of an initially expensive, but more corrosion-resisting material.

#### Ti Availability

In view of the heavy demands from the aircraft industry, the chemical engineer who finds that titanium answers a corrosion problem may question the availability of titanium. Order M-80 of the Business and Defense Service Administration of the Department of Commerce, allows the producers of titanium mill products to channel 10% of their output into non-defense applications. Therefore, even in periods of peak demand by the aircraft industry, deliveries of titanium to the chemical industry should not suffer appreciably.

Meanwhile, all producers of mill products are building up stocks for the more common industrial applications. In addition to this, reliable sources of supply are developing for such titanium items as tubing, welded fittings, valves, fasteners, flanged heads and other such items required by the chemical industry for process equipment.

#### Important Physical Properties of Ti—Table II

Density, lb./cu. in.	0.163
cm./cc.	4.51
Melting point.	3,135 F.
Magnetic permeability (at 20 oersteds).	1.00005
Modulus of elasticity, psi.	15,500,000
Mean linear coefficient of thermal expansion, in./in./°F.	
68-200 F.	$4.8 \times 10^{-6}$
68-1,400 F.	$5.7 \times 10^{-6}$
Thermal conductivity (Btu./hr./sq. ft./°F./ft.)	
68 F.	11.5
400 F.	10.4
Electrical resistivity (ohm-cm.) 68 F.	$54.8 \times 10^{-6}$
Instantaneous specific heat (Btu./lb./°F.) 68 F.	0.125

#### Physical Properties

The physical properties of major interest to the design engineer are listed in Table II. These properties are generally similar for all grades of unalloyed titanium.

Titanium's rate of heat transfer is about the same as austenitic stainless steels and far better than most non-metallic substances. This, combined with corrosion resistance, has led to



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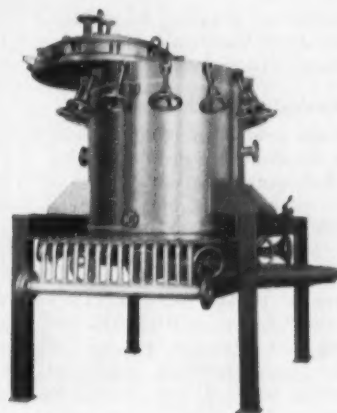
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Important Mechanical Properties* of Ti—Table III						
	40-65,000 Psi. Grade		55-80,000 Psi. Grade		70-95,000 Psi. Grade	
	Typical	Min.	Typical	Min.	Typical	Min.
Ultimate tensile strength, psi.	65,000	50,000	80,000	65,000	90,000	80,000
Yield strength (0.2% off-set) psi.	50,000	40,000	65,000	55,000	80,000	70,000
Elongation in 2 in.	28%	22%	25%	18%	20%	15%
Area Reduction	50%	30%	50%	30%	40%	30%
Bend Radius-105°V <sup>b</sup> (Sheet up to 0.070 in. thick)	1T <sup>c</sup>	1.5T	1.5T	2T	2T	2.5T
0.070 in. to 0.187 in. thick	1.5T	2T	2T	2.5T	2.5T	3T

\* Room temperature.  
<sup>b</sup> V-block is used as female die. Angle is bend with spring-back.  
<sup>c</sup> T equals ratio of bend radius to thickness of sheet.

replacing of plastics, glass and other such materials in many chemical process applications.

#### Mechanical Properties

Three grades of commercially pure titanium are produced with the following yield strengths at 0.2% offset; 40-65,000 psi.; 55-80,000 psi.; 70-95,000 psi.

As in the case of other metals, titanium becomes softer as the degree of purity increases. It's not practical to distinguish between the various grades of commercially pure or unalloyed titanium by chemical analysis—mechanical properties are used for this (Table III).

Although well over half the titanium used by the aircraft

industry is alloyed with aluminum, manganese, vanadium and other elements, there are relatively few applications in the chemical industry where alloys would be specified.

To date, none of the commercially available alloys show appreciably better corrosion resistance than the commercially pure grades. However, experimental alloys are now in the development stage which show superior resistance to hot concentrated reducing acids.

While the aircraft designer demands alloys for higher strength at elevated temperature, the designer in the chemical industry generally can use a steel shell, lined with titanium

so that strength of the titanium is of secondary importance. Further, since the unalloyed grades offer strengths equal to or higher than annealed stainless steel, these grades can be substituted directly for stainless without major design modification, and provide an increased factor of safety.

In certain applications, such as pump impellers, centrifuge bowls, turbine blades, high-speed reciprocating parts, strength-to-weight ratio may become as important to the chemical engineer as to the aircraft designer. For this reason, Table IV, outlining the chemistry and properties of the most widely used alloys is included.

#### Fabricating Titanium

One of the contributing factors to the rapid expansion of the titanium industry is that it can be fabricated with equipment designed for stainless steels. Once some experience has been gained and allowance made for the metal's special characteristics, titanium can be machined, formed and welded without difficulty.

The lower the yield strength of the titanium grade, the better its formability. A great deal of knowledge of optimum fabricating techniques for titanium has been developed as the result of the tonnage used by the aircraft industry and their sub-contractors. However, many of the special techniques used for high-strength alloys are unnecessary for fabricators in the chemical industry who will usually be working with unalloyed titanium

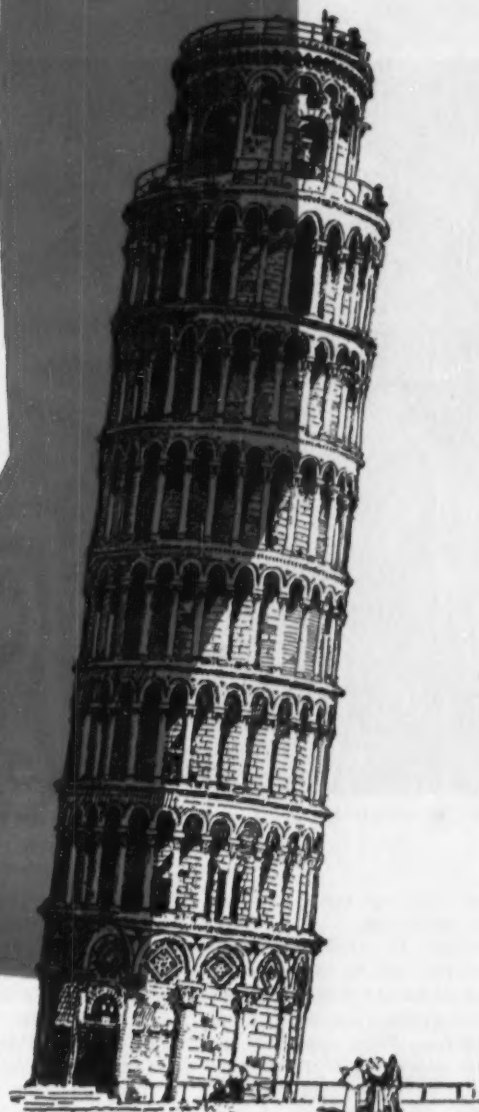
Some Widely Used Ti Alloys—Table IV

Alloy Code*	Major Characteristics	Forms Available	Nominal Chemistry	Ult. Ten. Str. (Min.)	Yld. Str. 0.2% off-set (Min.)	% Elongation (Min.)
C110M	Strength, excellent formability	Sheet, plate	8% Mn	120,000 psi.	110,000 psi.	10
C130AM	Maximum strength-weight	Bar, billet, wire, forgings	4%Al-4%Mn	140,000	130,000	10
C120AV	Moderate strength-weight	Bar, billet, wire, forgings	6%Al-4%V	130,000	120,000	10
A110AT	High temp. strength, weldable	Bar, billet, wire, forgings, sheet, plate	5%Al-2.5%Sn	115,000	110,000	10

\* Proposed by Rem-Cu as an industry standard.



## SOMEBODY GOOFED!



Only by a freak of fortune does the leaning tower of Pisa still stand. A faulty foundation was not apparent until the structure was three stories high. It is believed the architects were then forced to compensate by adding weight to the opposite side to save the building.

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The Amercoat Sales Engineer is trained in the principle that in corrosion engineering, too, foundations are all-important. You can put this factory-trained man on your staff, so to speak, without cost or obligation. His advice will be truly objective since it is based on a knowledge of all types of protective coatings and more than 43,000 case histories in our files. You can be sure that the Amercoat coating he recommends, whether vinyl, phenolic, epoxy or any other type, will be the right one for *your* job, and the most economical on the basis of cost per square foot per year.

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tinent data concerning your corrosion problems based on our nearly 20 years of corrosion control experience, and give you a comprehensive recommendation. In addition to recommending the proper coatings, he will assist you in writing complete specifications. However, this is not the full extent of his service: he will also be available for consultation at the job site to insure proper application.

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May we send you the name of the Amercoat man nearest you? Literature containing many helpful suggestions for the design and corrosion engineer is also available on request. Write to: Amercoat Corporation, 4809 Firestone Blvd., South Gate, Calif.

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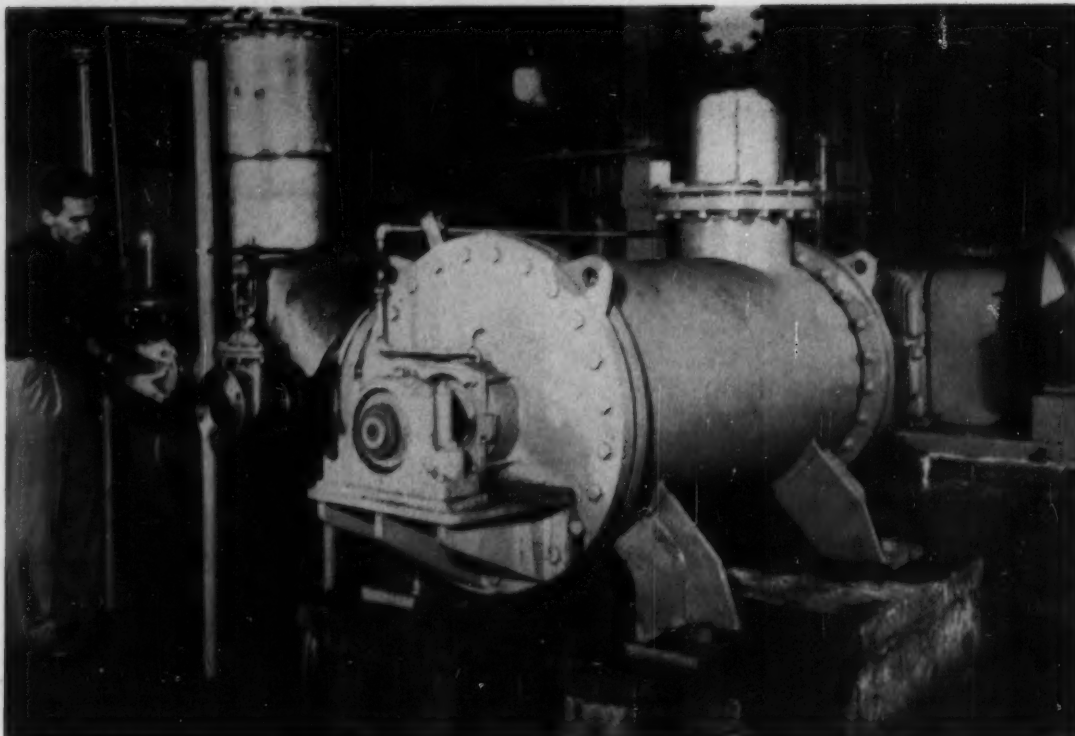
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TITANIUM-LINED barrel of chlorine dioxide mixer resists corrosion at the Riegel Paper Corp., Acme, N. C.

with a yield strength between 40 and 70,000 psi.

**Forming**—In sheet forming, it is important to observe the minimum bend radii outlined for each grade (see mechanical properties). Most forming operations can be performed successfully at room temperature. However, warm-forming at 300-800F. can materially reduce springback and the power required for the operation.

**Deep Drawing**—Unalloyed grades can be deep drawn to severe depths in the 800F. temperature range in a single operation. Powdered graphite is used as a draw lubricant at this temperature. Multi-stage drawing can be accomplished at room temperature with intermediate anneals at 1,000F.

**Spinning**—Deep spinning of titanium is most effective at about 800F. One technique is to use an aluminum covering on the wooden block to dissipate the heat when torch heating is used. In other cases, steel blocks are used.

**Machining**—The relative ease

of machining titanium grades is about proportional to their yield strength. However, all of the unalloyed grades may be machined without undue difficulty by making allowance for titanium's properties. Titanium has a tendency to seize the tool. This calls for sharp tools, (generally carbide), correct tool angles, heavy feeds and slow speeds.

Titanium has a lower thermal conductivity than most steels. This calls for an adequate coolant, applied as effectively as possible to the point of contact.

Generally, once sufficient experience has been gained, titanium can be machined easily.

**Annealing & Stress Relieving**—After forming, structural parts can be annealed or stress relieved for one hour at 850F. to 1,000F.

**Welding**—All unalloyed titanium grades are ductile weldable. Spot and seam welding does not require protective atmospheres and electrode pressures, welding currents and time cycles similar to those required for stainless steels are used.

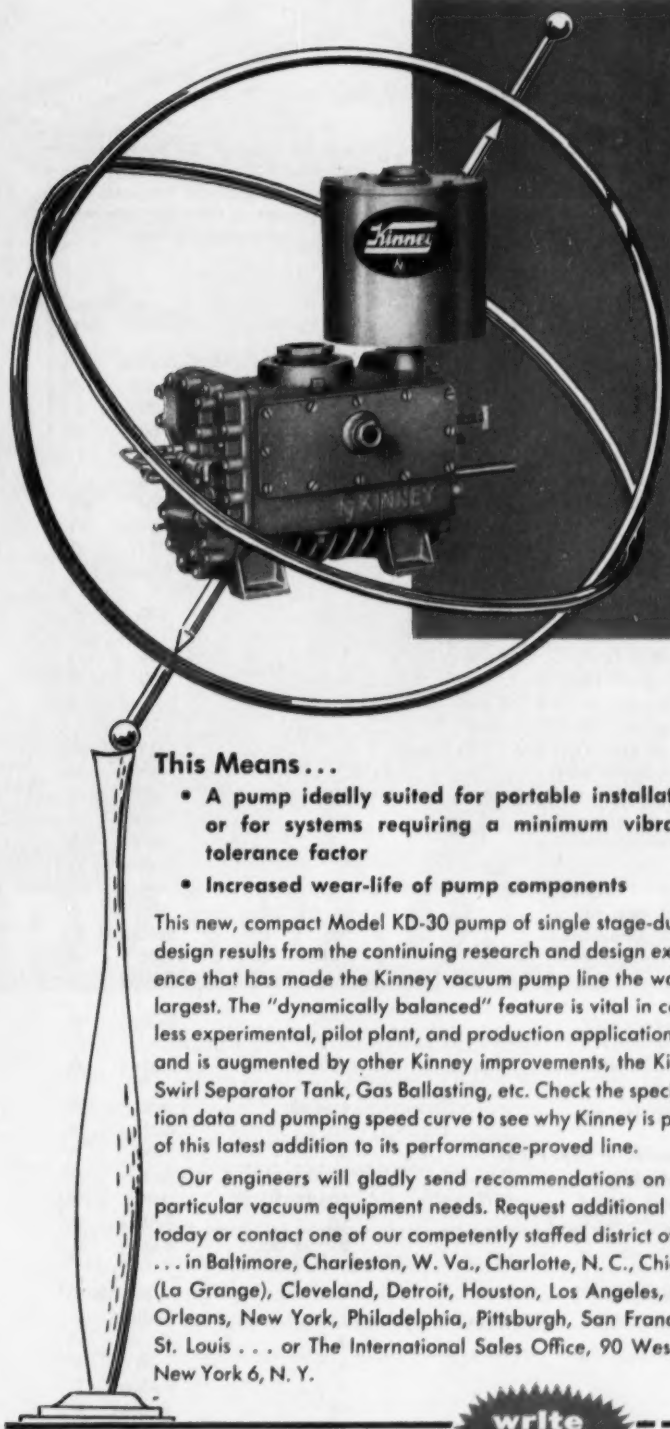
All fusion welding requires complete protection of the weld and heat-affected zone from oxygen and nitrogen. Most common method is inert arc welding with a protective blanket of argon or helium. Inert gas chambers also have been used. Automatic consumable electrode welding methods are frequently used for production welding operations on titanium.

Unalloyed titanium welds are characterized by excellent flow characteristics, strength, ductility and corrosion resistance equal to the parent metal. However, techniques have not been successfully worked out to weld titanium to steel or other engineering metals.

**Cleaning**—Titanium oxide scale is hard and abrasive. Its presence is detrimental to sheet forming and creates machining difficulties. Scale removal may be accomplished by oxidizing molten salt baths, grinding or grit or vapor blasting, followed by pickling in 20-30% HNO<sub>3</sub>-2% HF at 130F.

If the metal has not been





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NEW **Kinney**

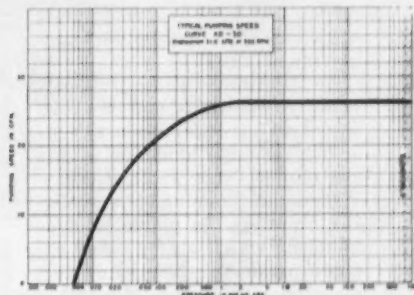
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PUMP IS FUNCTIONALLY  
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Our engineers will gladly send recommendations on your particular vacuum equipment needs. Request additional data today or contact one of our competently staffed district offices... in Baltimore, Charleston, W. Va., Charlotte, N. C., Chicago (La Grange), Cleveland, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis... or The International Sales Office, 90 West St., New York 6, N. Y.



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Ultimate Pressure (McLeod Gauge)	10 Microns
Free Air Displacement	30.4 CFM
Free Air Displacement	14.4 Liters/sec.
RPM	925
Motor H.P.	1 1/2
Motor RPM	1800
Oil Capacity	2 1/2 qts.
Cooling	Air
Shaft Diameter	3/4"
Inlet Connection	1 1/2" screwed
Outlet Connection	1 1/4" screwed
Valve Type	Poppet
Separator Tank	Kinney Swirl
Net Weight, Complete Unit	370 lb.

Overall Dimensions, Complete Unit with Motor  
Length - 28 3/4"; Width - 20 1/2"; Height - 19 1/2"

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heated over 1,100F, pickling in 20-30%  $\text{HNO}_3$ -2% HF will be sufficient to remove the contaminated surface layer.

#### Corrosion Resistance

The major interest in titanium's corrosion resistance is in those areas where titanium is resistant to attack and other engineering metals are not. To summarize in a field where generalizations are difficult:

- Titanium shows generally excellent resistance to chloride ion attack.

- Titanium excels stainless steels in nitric acid at elevated temperatures and pressures. Titanium shows very low corrosion rates in all strengths of nitric acid short of fuming concentrations.

- Titanium, under oxidizing conditions, will resist hydrochloric and sulphuric acids more effectively than most other engineering metals.

- Titanium and presently available alloys are not generally useful in strong concentrations of hot reducing acids, or in any hydrofluoric acid applications.

Titanium is completely resistant to attack in many chloride solutions which attack other engineering metals by pitting corrosion.

It is distinctly superior to other engineering metals in the following environments: Sodium and calcium hypochlorite solutions; chlorine dioxide; moist chlorine; organic chloride solutions; calcium chloride; ferric chloride and most other hot metallic chloride solutions. Titanium is completely inert in sea water and marine atmospheres, and shows excellent resistance to sodium chloride solutions at elevated temperature and pressure.

Titanium has a particularly useful range of applications in nitric acid at elevated temperatures and pressures. At 330F. (166C.) titanium shows a corrosion rate of 5 to 10 mils per year (0.005 to 0.010 in. per year) in 65% nitric acid—a range where stainless steels are very rapidly attacked.

A number of titanium reactors and autoclaves are in service, in nitric acid-organic mixtures, under conditions of

#### Latest Corrosion Data on Ti—Table V

The designations employed are those used by the "Corrosion Handbook." A rating of "A" means corrosion of not more than 5 mpy. (mils penetration per year). Class "B" implies rates between

5 and 50 mpy. A "B" rating may be satisfactory for non-critical parts where some corrosion can be tolerated. Class "C" indicates a corrosion rate above 50 mils penetration per year.

Reagent*	Concentration % by Weight	Temp. °C	Rating
Acetic acid . . . . .	5, 25, 50, 75, 99.5	Boiling	A
Acetic anhydride . . . . .	99	Room	A
Aluminum chloride . . . . .	5, 10	100	C
	25	80	A
	25	100	A
Ammonia, anhydrous, 200 psi . . . . .	100	40	A
Ammonium chloride . . . . .	1, 10, saturated	100	A
Ammonium hydroxide . . . . .	28	Room	A
Aniline hydrochloride . . . . .	5, 20	100	A
Aqua regia (1HNO <sub>3</sub> :3HCl) . . . . .		Room	A
Barium chloride . . . . .	5, 20	100	A
Calcium chloride . . . . .	5, 10, 25, 28	100	A
Calcium hypochlorite . . . . .	2, 6	100	A
Carbon tetrachloride (with 1% water) . . . . .		Boiling	A
Chlorine gas (dry, 0.005% water) . . . . .		30	C
Chlorine gas (wet, more than 0.013% water) . . . . .		75	A
Chlorine saturated water . . . . .		Room	A
Chloroacetic acid . . . . .	30	80	A
	100	Boiling	A
Chloroform-water mixture . . . . .		Boiling	A
Chromic acid . . . . .	10	Boiling	A
	36.5	90	A
Citric acid, aerated . . . . .	10, 25, 30	100	A
Citric acid, nonaerated . . . . .	50	Boiling	B
Cupric chloride . . . . .	1, 20	100	A
	40	Boiling	A
Dichloroacetic acid . . . . .	100	Boiling	A
Ethylene dichloride . . . . .	100	Boiling	A
Ferric chloride . . . . .	1 to 30	100	A
	10	Boiling	A
Ferric chloride + 10% NaCl . . . . .	5	100	A
Formaldehyde . . . . .	37	Boiling	A
Formic acid, aerated . . . . .	10, 25, 50, 90	100	A
Formic acid, nonaerated . . . . .	10	Boiling	A
	25, 50, 90	Boiling	C
Hydrochloric acid . . . . .	1	70	A
	1	Boiling	C
	3, 5	Room	A
	3, 5	70	B
	3, 5	Boiling	C
	10	Room	B
	10	70	C
	20, 37	Room	C
Hydrochloric acid-200mg. Cu <sup>++</sup> /liter . . . . .	37	Room	A
Hydrochloric-nitric acid mixtures: (HCl:HNO <sub>3</sub> ) . . . . .	1:3	Room	A
	2:1	Room	A
	3:1	Room	A
	4:1	Room	A
	5:1	Boiling	B
	7:1	Room	A
	20:1	Room	A





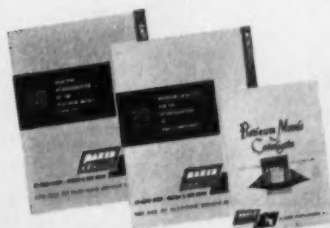
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temperature and pressure where life of stainless equipment has been limited.

Although titanium is generally attacked by strong reducing acids, particularly at elevated temperatures, titanium finds some of its best applications in sulphuric and hydrochloric acids.

Titanium is completely inert in 50% sulphuric when anodically protected. This makes it an excellent material for racks in anodizing, plating and electropolishing baths. Pre-anodizing titanium in 15%  $H_2SO_4$  drastically reduces corrosion in 55%  $H_2SO_4$ .

Equally important is the inhibiting effect of traces of oxidizing agents in both sulphuric and hydrochloric acids. Traces of cupric ion and chromic acids are very effective inhibitors in sulphuric acid. Cupric and zinc chlorides and potassium dichromate have been found to be effective inhibitors in 10 to 20% HCl solutions.

Nitric acid has a very strong inhibiting effect in both sulphuric and hydrochloric acids. Titanium is almost completely resistant to hot aqua regia and to many other HCl- $HNO_3$  or  $H_2SO_4$ - $HNO_3$  mixtures.

Table V gives a summary of laboratory corrosion data on titanium.

Titanium corrosion testing is necessarily incomplete. Additional studies are in progress to develop more fundamental data and throw more light on the mechanism of corrosion and the nature of titanium's attack-resisting film. Meanwhile, data are being compiled on titanium's behavior in various mixtures of chemicals under specific industrial applications. Both types of information will be useful to the chemical process industry's search for better corrosion resisting materials.

However, on the basis of well-established data, from the laboratory, the pilot plant and the process industry, titanium has been shown to have a distinct advantage over any other structural metal in many corrosive environments. Expanding use of titanium equipment will certainly be a factor in eliminating the corrosion losses now plaguing the chemical industry.

### Latest Corrosion Data on Ti (continued)

Reagent*	Concentration % by Weight	Temp. °C	Rating
Hydrofluoric acid	1	Room	C
Hydrofluoric acid, anhydrous	100	Room	B
Hydrogen sulfide (saturated water)		70	A
Lactic acid, aerated	10, 25, 50, 85	100	A
Lactic acid, nonaerated	10, 25, 50, 85, 100	Boiling	A
Magnesium chloride	5, 20, 42	Boiling	A
Manganese dichloride	5, 20	100	A
Mercuric chloride	1, 5, 10, saturated	100	A
Nickel chloride	5, 10	100	A
Nitric acid	10, 20, 30, 40, 60, 70	100	A
	50	100	A
	65	Boiling	A
Nitric acid, red fuming		Room	Not recommended
Nitric acid, white fuming	98	Room	
Nitric acid, under equilibrium pressure	65	166	A
Oxalic acid, aerated	0.5, 5, 10	35	A
	0.5, 1, 5, 10, 25	60	C
Phosphoric acid	5, 10, 20, 30	35	A
	35 to 85	60	B
	5 to 35	100	B
	5	100	B
	10	80	C
Potassium hydroxide	10	Boiling	A
Sodium chloride	20, saturated	Boiling	A
Sodium hydroxide	10	Boiling	A
	40	80	A
Sodium hypochlorite (5.6% $Cl_2$ )		Room	A
Sodium sulfide	10	Boiling	A
Stannic chloride	5, 24	100	A
Stearic acid	100	180	A
Sulfur dioxide (saturated water)		Room	A
Sulfur dioxide (saturated water)		70	A
Sulfur, molten	100	240	A
Sulfur, water suspended		Room	A
Sulfuric acid	5	35	A
	10	35	B
	20-50	35	C
	60-70	35	B
	above 70	35	C
Sulfuric-nitric acid mixtures: ( $H_2SO_4$ : $HNO_3$ )	10:90	35	A
	30:70	35	A
	50:50	35	A
	60:40	35	A
	70:30	35	B
	80:20	35	B
	90:10	35	B
	99:1	35	B
Tannic acid	25	100	A
Tartaric acid	10, 25, 50	100	A
Tetrachloroethane, water mixture		Boiling	A
Tetrachloroethylene, water mixture		Boiling	A
Trichloroacetic acid	100	100	C
Trichloroethylene, stabilized water mixture		Boiling	A
Trichloroethylene, unstabilized, water mixture		Boiling	A
Zinc chloride	5, 10, 20	Boiling	A

\* Solutions were not aerated with air unless otherwise indicated.



1906



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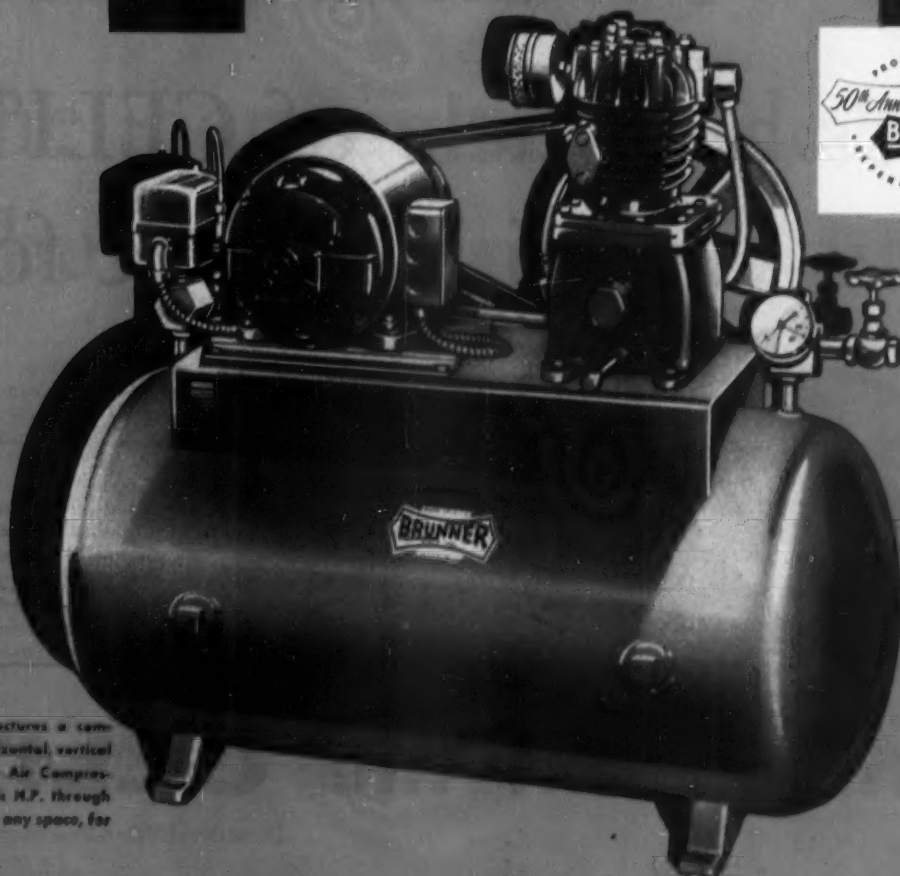
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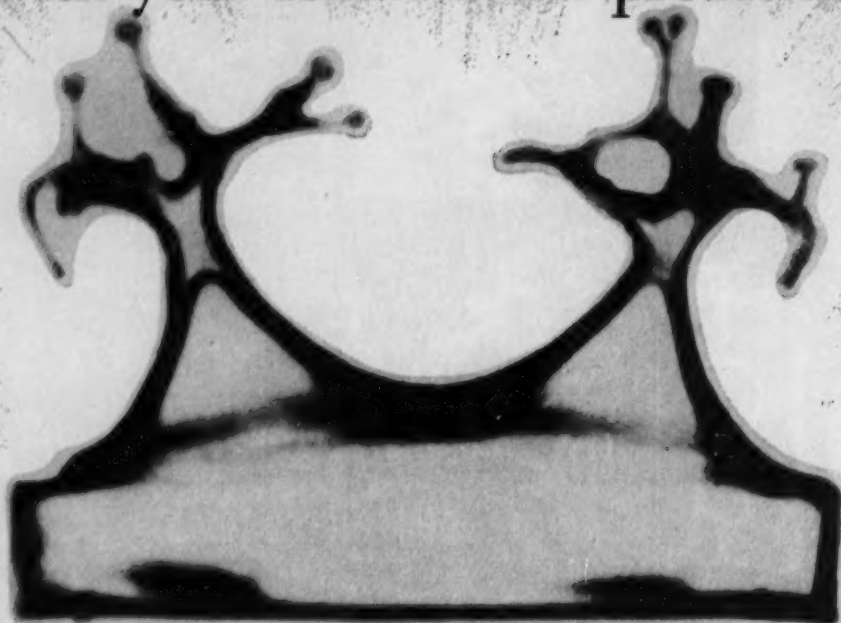
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What's this <sup>66</sup>CROWN<sup>99</sup> got to do  
with your formulation problems?



This is a particle of Celite diatomaceous earth. The genus is *Di cladia*, species is *Capreolus*. Loosely translated it means "two-sided branch." This particle is just one of hundreds of different intricate particles that together make Celite such an efficient mineral filler. When placed under a microscope *Di cladia Capreolus* becomes a rustic "crown."


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The secret of diatomite's remarkable properties—The infinite variety of particle shapes and sizes gives Celite diatomite its exceptional performance characteristics in a wide range of process applications. Irregular shapes like the "crown" prevent packing down for high bulking action.

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erties. Its light porous mass provides great absorptive capacity, permitting preparation of high concentrate insecticides and other liquids in a dry, free-flowing powder form. The vari-shaped microscopic particles have large surface areas which serve to extend pigments in paint and paper-making. Other important uses include molded plastics, matches, concrete, acetylene tank fillers and adhesives.

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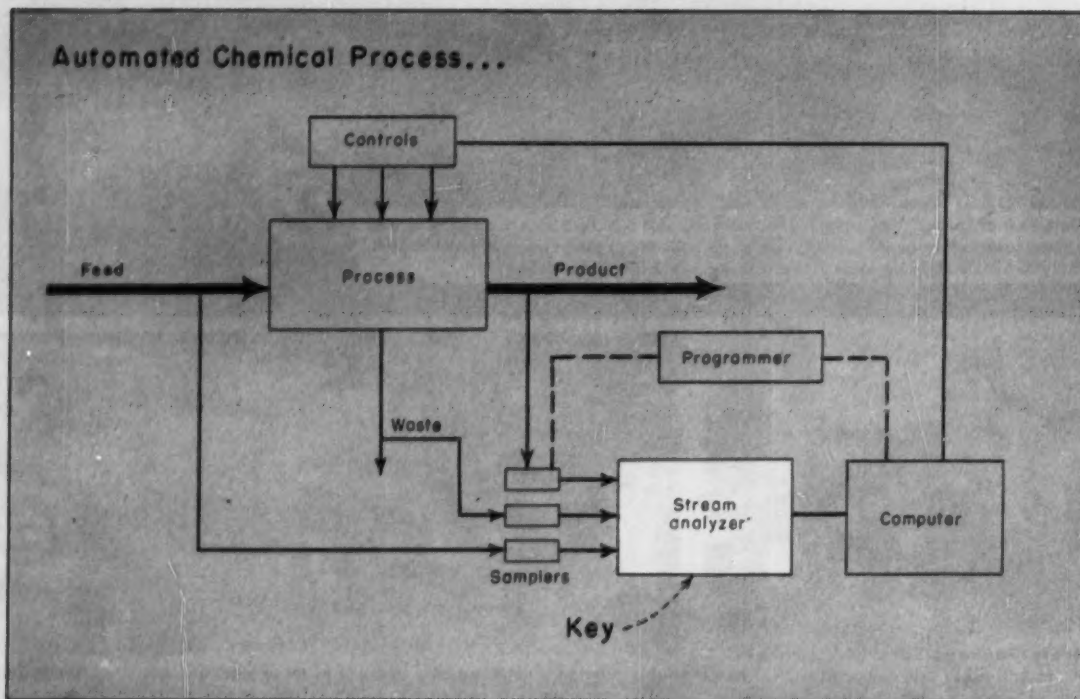
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## Analyzers Unlock Process Control

**Instrument conclave emphasizes rising stature of continuous plant stream analyzers. New instruments point toward automation in the chemical industry.**

Better techniques of analysis instrumentation are needed before automation can win its spurs in the chemical industries.

With this thought, Ralph Munch of Monsanto Chemical Co. opened the session on New Techniques in Analysis Instrumentation at the 11th Annual ISA Conference in New York during mid-September. In this and related sessions, instrument engineers spelled out their progress toward this goal.

At the sessions, engineers heard:

- That gas chromatography has leaped from laboratory to plant stream, can analyze hydrocarbon streams through C<sub>4</sub>

with an elapsed time of 30 min. or through C<sub>6</sub> within 5 min.

- That a new radiological gas analyzer is increasing output of an ammonia synthesis plant by controlling argon content in the recirculating stream.

- How process mass spectrometers increase the yield in a sulfur recovery plant by de-

termining the H<sub>2</sub>S-SO<sub>2</sub> content of reactor effluent so that the correct stoichiometric balance can be held; maintain efficient absorption of acetylene from acetylene-ethylene stream without absorption of ethylene; monitor metallurgical vacuum refining cycle so that reducing agent may be added at proper time.

- That the ancient principle of refractometry is applied in new plant stream instruments that remain operable under severe plant conditions and are not affected by temperature variations.

- That a new differential photoelectric stream colorimeter offers increased sensitivity and stability at less cost.

► **Part of Major Effort**—What instrument men are probing for in these and developments still to come is the fully automatic process plant. Suitable sensing

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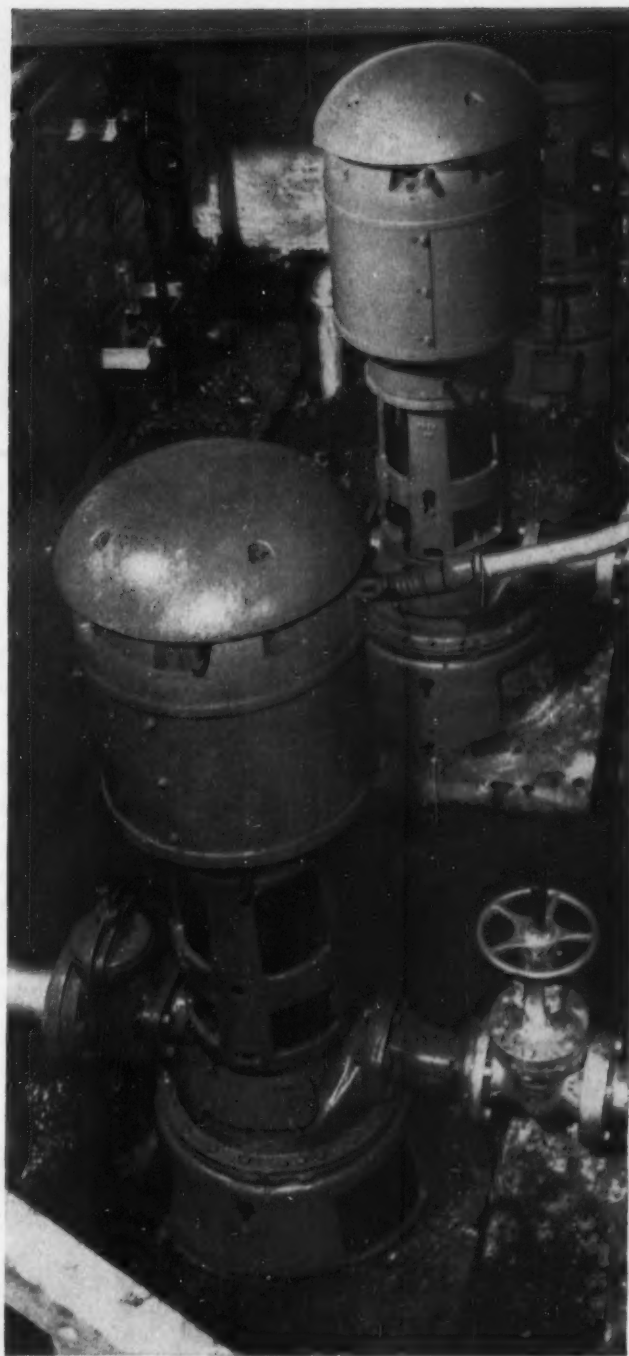
# 17 pump-years of service at \$1<sup>52</sup> per month for repair parts

The three Type G LaBour pumps in this picture have delivered a total of seventeen years of service to the Sharon Steel Corporation, Sharon, Pa. The first pump was installed in 1948, the second in 1949, and the third in 1953. The pumps are handling pickling solutions at 100° to 120° F.

Sharon Steel Corporation has purchased \$930 worth of parts for these pumps, some of which were spare parts not for immediate use. Counting them all, however, it figures only \$18.25 per pump per year of service.

Since fewer part replacements are required, the true saving made possible by LaBour pumps is greater than the mere comparison of parts cost. Usually the labor and down-time are more costly by far than the parts themselves.

If you're after real economy in pumping corrosive liquids, you'd better look at LaBour. When *all* the figures are in—first cost and maintenance total—after years of service, LaBour is the bargain pump of the field.



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### New Instruments & Controls

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devices would transmit continuously into a computer the composition of feed, product and waste streams. Acting on these data and pertinent market and inventory information, the computer would actuate controls to attain high efficiency and optimum economic return.

While such control systems are yet to be achieved, these stream analyzer developments indicate noteworthy progress on the sensing end of the loop during the past year. For your information, we present highlights on some of these new devices in the following roundup.

#### Analyzers . . . CHROMATOGRAPHIC

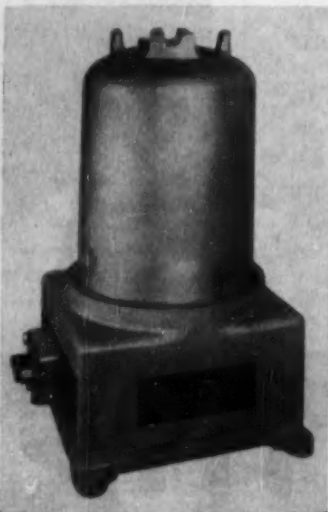
Gas chromatographic analysis techniques now have been extended from the laboratory into practical, operating plant stream analyzers. Speaking before the ISA conference in New York, David Fuller outlined the features of Foxboro's instrument. Meanwhile, down at the equipment exhibit on the floor of the Coliseum, sales engineers of the Watts Mfg. Co. were talking about their vapor fraction analyzer for chromatographic analysis of plant streams.

Apparently, these two instru-

ments are the first chromatographic stream analyzers to appear on the instrument market.

Basically, they operate the same as a laboratory unit. But there the similarity ends because they have been designed to operate reliably under rugged plant conditions. Sampling, analysis and recording are automatic.

► **What They Offer**—Output from a chromatographic stream



STREAM is analyzed by explosion-proof chromatographic unit.

analyzer is reported directly as gas stream composition. This enables the process to be controlled to produce optimum balance of the composition. And the rapid chromatographic analysis permits control action within minimum time.

Indicative of the performance, Foxboro reports that analysis times on multi-component hydrocarbon streams have run from 5 min. for methane, ethane and the propanes up to 30 min. for ethane, ethylene, propanes (including propylene), butanes and butenes. Watts says that on an ethylene recovery system their instrument can analyze a stream in approximately 12 min.

► **How Instrument Works**—In the Foxboro instrument, the sample passes directly from the process to the sampling system. If a liquid, the sample is vaporized by heating and/or pressure reduction. Precautions assure that the vapor composition is identical to composition of the liquid sample.

Both the sample vapor and the inert carrier gas are conditioned to closely held temperature and pressure.

Then, on a signal from the programmer, the sampler rotates 90 deg. so that a fixed





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**SHELLWAX®**

... fully refined paraffin waxes

Available in a wide melting point range (125-180° F.). These are highly stable with negligible oil content. They provide coatings with high gloss and excellent resistance to water vapor transmission.



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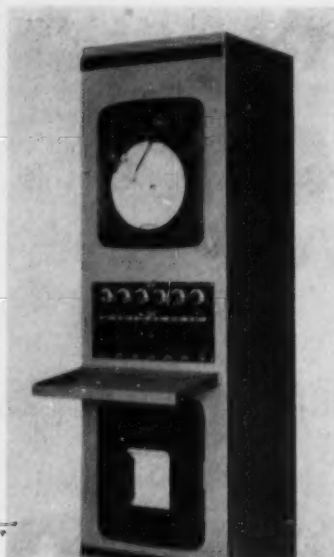
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CONTROL room panel used now with Foxboro's chromatographic analyzer.

volume or slug of sample is pushed into the column by the stream of carrier gas. With a properly selected column packing for a given stream, each component passes through the column at a different rate. As each component discharges in turn, it is detected by a thermal conductivity cell.

Output from the detector is a series of waves. Concentration of the gas component is a function of the area under the wave and is computed and recorded automatically.

► **Experience to Date**—Fuller admits that actual experience with plant-stream analyzers so far is quite limited. Yet with units designed specifically for plant use, results have been uniformly good.

Column life onstream still is unknown. Largely, it will be determined by whether there is any influx of unknown or heavy fractions.—The Foxboro Co., Foxboro, Mass.; 254A Watts Mfg. Co., Ronceverte, W. Va. 254B

#### Analyzers . . . RADIOLOGICAL GAS

For more than two years plant-model radiological gas analyzers have been recording argon and ammonia content of

the circulating gas in ammonia synthesis plants of the Shell Chemical Corp. at Pittsburgh and Ventura, Calif. The technique also has been used for detection in gas-liquid partition chromatography and for studying diffusion processes in beds of porous catalyst carriers. Potential applications are foreseen in many other industrial processes.

The instrument operates by measuring the ionization produced in a gas mixture by beta radiation from a radioactive source. The ionization chamber does not distinguish one component from among a mixture of several. Thus, the instrument is effective only on binary mixtures and interfering components must be removed before the sample stream reaches the ionization chamber.

► **Controls Bleed**—In ammonia synthesis plants, the radiological gas analyzer has proved well adapted to control of bleed rate on the recirculating gas stream. Purpose of the bleed is to hold the concentration of argon in the stream at an optimum level.

Above this optimum the argon is sufficiently concentrated to hurt the ammonia conversion efficiency; below it the rate of bleed is sufficiently high to waste synthesis gas needlessly. With the radiological gas analyzer, argon concentration in the circulating gas stream is recorded continuously to permit controlling the bleed rate at the optimum point.

Recording of ammonia concentration in the circulating gas also has been found useful to check the operation of the ammonia condensing system and to follow the catalyst formation in its early stages.

► **Removal System**—Since the radiological analyzer is a binary instrument, it is necessary in the ammonia plant application to remove ammonia and hydrogen from the sample in order to record the argon from the entering air which builds up in the circulating gas.

Ammonia is removed by two silica gel absorbers, which are connected in a self-regenerating system controlled by solenoid valves and a cycle timer.

This system can be bypassed when the sum of argon plus ammonia in the stream is to be recorded.

Hydrogen is removed from the sample by allowing it to pass through a hot palladium tube, where it diffuses into a surrounding jacket and is swept away by a countercurrent purge of nitrogen or carbon dioxide.

► **Measuring Unit**—In addition to the removal systems, the instrument as used in ammonia synthesis plants includes a thermostated measuring unit, an electrometer amplifier and temperature control amplifier. A potentiometer type recorder is used to record the analyzer output and may be installed at a remote location.

In the measuring unit, two ionization chambers are built integral with a thermostat block. One ionization chamber is purged continuously with the sample while the other is purged with a reference gas such as nitrogen.

Gases in the two chambers are ionized by beta particles from two sealed strontium-90 radioactive sources. The difference between the two ion currents is amplified and recorded.

Instrument is furnished in



BINARY mixtures of gases are analyzed with this radiological plant stream analyzer.



more for your  
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with stainless

ONLY ONE  
IS GOOD ENOUGH

The best stainless tubing for a specific application cannot be identified by surface appearance alone. The answer is found in the grain structure. Because your guarantee of satisfactory service rests *inside* the metal, it is most important for the stainless tubing buyer to consider his supplier's methods of manufacture.

Corrosion resistance, which prevents product contamination, depends upon heat treatment. Heat treatment of stainless steel tubing for a specific end use may vary according to grade, size of tube and service requirements involved. For instance, the austenitic grades of stainless steel have optimum corrosion resistance only when all carbides have been dissolved and retained in solution by rapid cooling. At B&W, heat treatment is rigidly controlled, and every piece of stainless tubing is heat treated to provide optimum corrosion resistance when that property is required.

For virtually any application—pressure or mechanical—B&W can provide either seamless or

welded stainless tubing in any number of grades, in a broad size range. Help is available through B&W Regional Sales Offices and a nationwide network of experienced tubing distributors. Mr. Tubes—your link to B&W—will be pleased to furnish detailed answers to your stainless tubing problems. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.



TA-6066-P

Seamless and welded tubular products, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels



either standard or explosion-proof construction.—**Hallikainen Instruments, 1341 Seventh St., Berkeley, Calif.** 256A

#### **Analyzers . . . PROCESS REFRACTOMETER**

For many years if you wished to use refractive index for analysis you did it with a laboratory instrument. Or, in more recent years, if you worked for one of the major chemical companies you may have seen continuous flow refractometers designed and built by the company for a specific process. But until very recently, you could not purchase such an instrument on the open market.

Now, industrial refractometers are available from at least three manufacturers. According to one manufacturer, within the next few years such instruments will become familiar for monitoring plant processes in almost every industry that produces transparent liquid products.

► **Where They'll Work** — One clear-cut advantage of the refractometer is its ability to work on aqueous solutions where infrared analyzers are ineffective. In general, refractometers can be used to: analyze mixed petroleum fractions that have boiling points within a few degrees of each other to detect composition changes of 0.1% or less; check blending or analysis of two components in a mixture; adjust concentrations of aqueous and other solutions; monitor processes such as the hydrogenation of edible oils; monitor the effluent from a chromatographic column.

Refractometers can even be applied outside the visible range using near infrared or ultraviolet to penetrate substances such as tar. Photocells sensitive to the particular wave length are used in such instances.

Two continuous flow refractometers with basically similar designs were described before the ISA Conference in New York by representatives of Barnes Engineering Co. and Manufacturers Engineering Equipment Corp. Because of the similarity and our lack of space we shall describe the Barnes instrument only.

► **Compound Cell** — Refractive

index is measured by passing monochromatic light through a hollow prism containing the sample liquid and through a second prism cell containing a reference liquid similar in nature to the sample.

The prism cells are arranged base to apex so that light transmitted through the compound cell emerges in the same direction, regardless of whether the index is 1.2 or 1.7 or something in between.

Any small change in the index of the sample deviates the light beam slightly from its original direction. Within certain limits, this deviation is proportional to the difference in index of the two liquids, not to the absolute value of either.

Actually, in the commercial instrument a mirror is placed to reflect the light beam back through the cell thereby doubling the deviation. A glass dividing plate splits the light beam between two photovoltaic cells. If one cell receives more light than the other it actuates movement of a glass plate which shifts the beam laterally until both cells are receiving equal amounts of light. The amount of plate rotation needed is a measure of the change in sample index.

► **Temperature Equalizes** — Sample fluid flowing through the cell is separated from the reference liquid only by the inner wall. Any temperature differential equalizes so that they are at the same temperature. For greater precision than the fourth decimal place, a separate heat exchanger is used ahead of the cell.—**Barnes Engineering Co., Stamford, Conn.; 258A Manufacturers Engineering Equipment Corp., Hatboro, Pa.** 258B

#### **Control Unit**

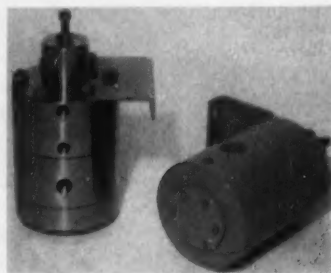
**Speedy action eliminates lag and hunting problems.**

Electronic and hydraulic components are combined in the new Swisstrol unit to control processes accurately and rapidly.

Unit is adaptable to any manufacturing process. With minimum equipment, it solves control problems involving pressure, vacuum, temperature, liquid level,

flow or condensate drainage.

Changes in process conditions are detected with electronic rapidity and transmitted instantly to a hydraulic operator. For valves, these are hydraulic cylinders; where rotary motion is required a fluid motor is used. Such operators can be fitted to any type of valve.—**The Swiss Colony, Engineering Div., Monroe, Wis.** 258C



#### **Sample Vaporizer**

**Feeds pressure-controlled vapor to stream analyzers.**

A new vaporizer-regulator assures vaporization at controlled pressure of liquid samples being fed into stream-type analyzers. It is used with infrared analyzers, refractometers and mass spectrometers.

Device operates at inlet pressures up to 150 psi. Pressure of the vapor is held constant within 0.10 psi. when upstream pressure does not vary more than 10 psi. Outlet pressure may be regulated from 0 to 50 psi. Maximum steam pressure for vaporizing is 50 psig; maximum output of heater, if used, is 75 w.

The Type 38-001 vaporizer regulator is a cylinder 6½ in. high by 3½-in. dia. It is built either in stainless steel or aluminum.—**Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif.** 258D

#### **Turbidity Monitor**

**Dual-beam unit, first of its type on market.**

The newly developed Turbi-stat instrument continuously monitors turbidity in fluids and





**75** years ago  
and 3 years before the first  
American Skyscraper was built



**Koven**  
was making individualized chemical equipment

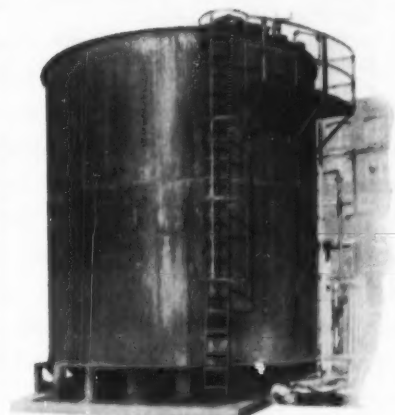
Experience and perfection go into the making of KOVEN Individualized Equipment . . . 75 years of careful devotion to detail, of time and research spent in making each piece increasingly better and more efficient at the lowest possible costs.

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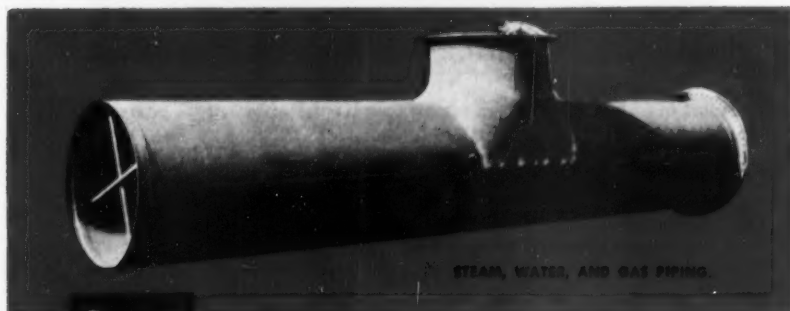
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BULK STORAGE TANK MADE OF STEEL



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#### SPECIALISTS IN INTRICATE FABRICATION USING:

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**Koven** FOR INDIVIDUALIZED EQUIPMENT SINCE 1881

L. O. KOVEN & BRO., INC., 154-A OGDEN AVE., JERSEY CITY 7, N. J.  
PLANTS: JERSEY CITY, N. J. • DOVER, N. J. • TRENTON, N. J.





measures suspensions as low as 0.05 ppm. Color changes in the process stream do not affect instrument readings.

First unit of its type, this instrument operates by comparing light scattered by suspended particles with light transmitted by the fluid. Errors from common-mode effects are reduced, zero drift is nil.

The Turbistat can be coupled to a side stream or used directly in any stream up to 3-in. dia.—**Baird Associates-Atomic Instrument Co.**, 33 University Rd., Cambridge 38, Mass. 258E

### Electronic Miniatures

**Recorders and indicators monitor complete process.**

A new line of miniature electronic recorders and indicators makes possible a complete graphic panel or console-type operation on a process.

The Dynamaster recorder looks identical to the Metagraphic pneumatic recorder. Indicating models are available, also. Both recorder and indicator have plug-in design for full interchangeability.

Although using standard components, the unit is housed in a case only 5 in. square. Yet, accuracy and sensitivity are equal to standard 12-in. instrument.

Instruments are offered in either potentiometer or a.c. bridge models. They can measure and indicate or record any variable such as temperature, pressure, flow, etc., which may be converted into an electrical quantity.—**The Bristol Co.**, Waterbury 20, Conn. 260A

### Electric Valve Actuator

**For proportional position, control uses no fluids.**

New Series D valve actuator is an all-electric device used with modern proportional-position electronic-control systems. This actuator combines the features of an all-electric system with the mechanical simplicity and ruggedness of commercial pneumatic operators. Yet, it uses no fluids.

The actuator utilizes a rising

stem movement, rather than a crank arm. It comes equipped with a mounting yoke similar to those used in cylinder-type pneumatic actuators. Thus, it mounts easily on any sliding-stem valve body.

The entire system is sensitive to 0.5% of controller signal span. Repositioning accuracy is at least 0.5% of stem travel. Rated output is 500 lb. thrust with a stem speed of 4 in. per min.—**Conoflow Corp.**, 2100 Arch St., Philadelphia 3, Pa. 260B

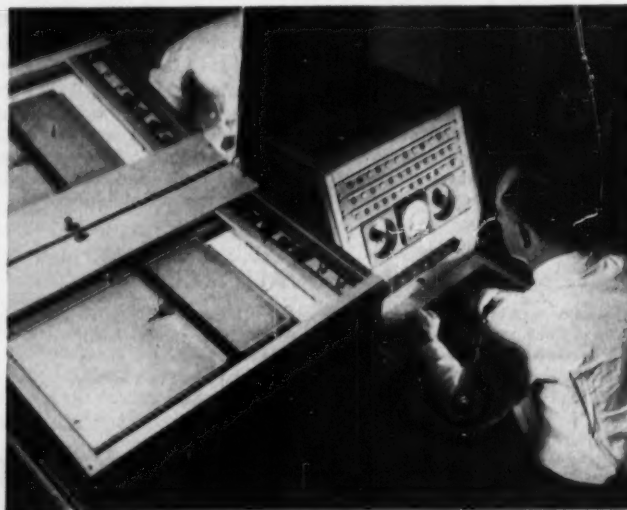
### Gas Analyzer

**Versatile instrument for plant or laboratory.**

A rugged new mass spectrometer for analyzing gases operates by radio frequency

rather than the more conventional magnetic principle. It has been used successfully to monitor refinery gas streams, analyze oil-well drilling muds in the field, control air reduction products and analyze stack and exhaust gases in the study of air pollution.

This instrument alternately monitors any six preselected gases in the range from mass 12 to mass 100. In a number of applications, the instrument is switched manually from mass peak to mass peak. An accessory permits selected gases to be monitored cyclically at the rate of one every ten seconds. Only a few milliliters flow per min. is required for highly accurate readings.—**Beckman Instruments Div.**, Scientific Instruments Div., 2500 Fullerton Rd., Fullerton, Calif. 260C

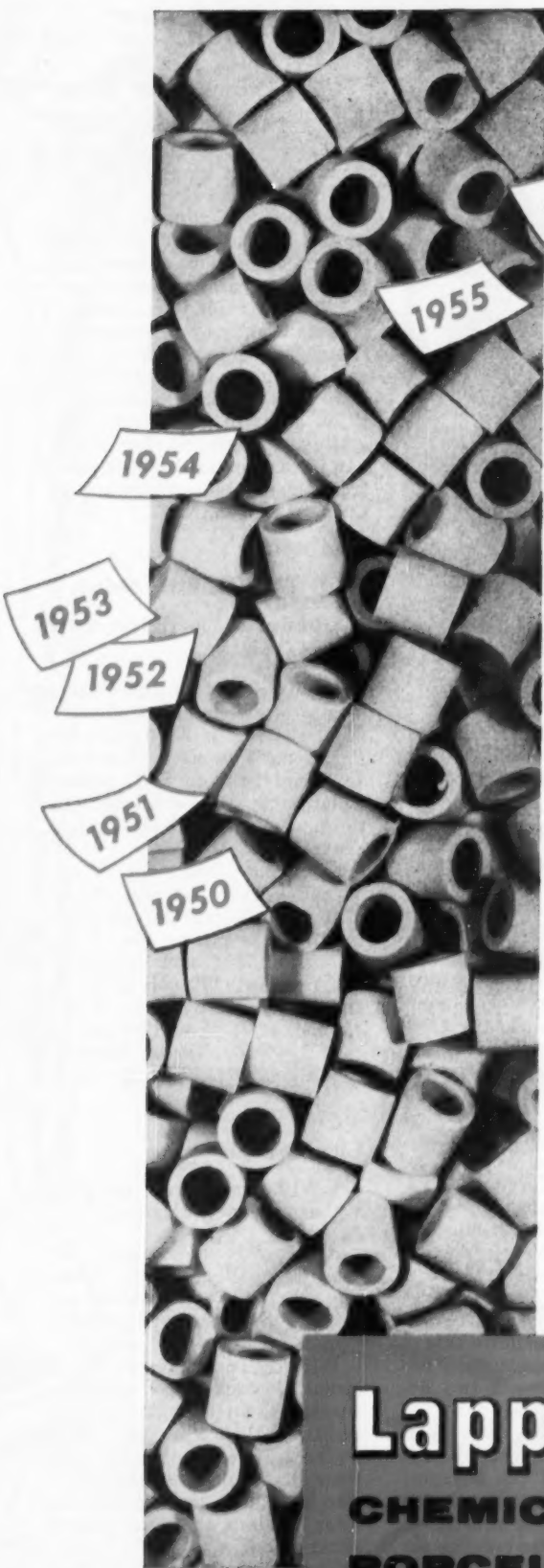


### Electronic Intellect Knows Right From Wrong

Intelligence built into this new electronic brain enables it to distinguish between right and wrong decisions, promises to revolutionize control of complex industrial processes. Here Dr. Robert Hooke, Westinghouse research scientist, operates the Automex on a problem analogous to a man trying to climb a mountain in total darkness.

Computer must "reach the top with the fewest steps in the shortest time." It can decide after every step whether it took the right or wrong step. Based on this decision, the next step it takes is the one most likely to succeed. No equation is needed.—**Westinghouse Electric Corp.**, Research Laboratories, Pittsburgh, Pa. 260D





**LONGER  
CONTINUOUS SERVICE**

**...WITH LAPP PORCELAIN  
RASCHIG RINGS**

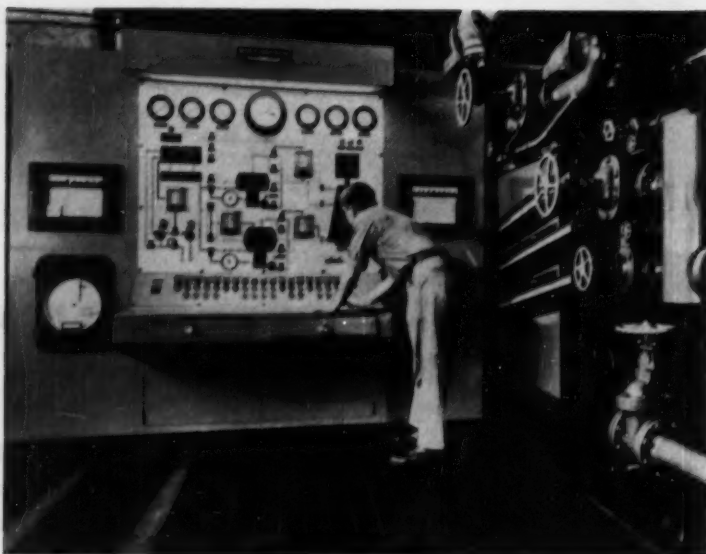
Lapp Porcelain Raschig Rings are your best bet for Process Tower packing for two important reasons . . . purity and strength. Lapp raschig rings are non-porous, completely vitrified and iron-free. They are chemically inert to acids of all concentrations (except hydrofluoric), will not crumble and will not absorb liquids which could later contaminate the product being processed.

As for strength, Lapp raschig rings are dense, hard and close-grained. They are tougher against damage from handling and tower operation than other ceramic rings or other packing shapes. Because Lapp rings are so strong and inert, they seldom need replacement. Hundreds of satisfied customers back up our claim of longer continuous service—with real savings. Get the full story on Lapp Chemical Porcelain—see for yourself how this initially low-cost material can save you money while providing a sounder processing system.

*WRITE for our bulletin containing description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 808 Wendell St., Le Roy, New York.*

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**CHEMICAL  
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## Loop Checks Out Compressors

**Performance of new designs is checked rapidly under wide range of simulated field conditions. Mass of data is processed on electronic computer.**

New centrifugal compressors designed for industrial air conditioning and refrigeration now are checked out by Worthington Corp. on a test loop that produces much wider test conditions than field tests can give. Within hours or a few days it answers performance questions that formerly required months of effort.

Believed to be the first of its kind, the facility is a closed-circuit test loop with electronic digital computer. It is controlled automatically. Compressor performance can be determined independent of system performance. Also, a compressor can be tested with all the commonly used refrigerants.

► **Test Run**—When a working model of a new compressor has been built, it is connected into the test loop. Field test conditions are set up similar to those to be encountered in an industrial or commercial installation.

After starting, the automatic controls bring the compressor

to the prescribed set of operating conditions. Flow, pressure, temperature, power consumption, etc. are fed into the electronic computer which translates the figures into useful performance characteristics. To completely evaluate the real fluid thermodynamic relationships of the gas as well as compressor performance requires 603 programmed steps.

► **Heat Removal**—Heat must be removed from the circulating gas in order to hold the test loop in balance. Gas discharging from the compressor is divided: one stream flows into a shell and tube condenser; the other is split between two desuperheaters.

Condensate from the shell and tube condenser feeds the spray headers of the desuperheaters. One desuperheater cools the gas to a prescribed temperature for the compressor suction. The other provides gas for the interstage flash gas connection of the compressor.

► **Control Panel**—The system has a graphic control panel from which a single operator can control and obtain the results of a test run. Miniature control indicators on the panel tell at a glance how closely conditions approach the set points.

The flow recorders contain mechanical analog computers that compensate for the various refrigerants used. They provide a direct reading of flow quantities, accurate within  $\pm 2\%$  for setting up test points. Final flows are calculated by the electronic computer.—Worthington Corp., Harrison, N. J. 262A

## PVC Expansion Joint

**Designed for rigidly fixed PVC piping.**

The first slip-type pipe expansion joint of unplasticized polyvinyl chloride is now available in 1, 2 and 3 in. sizes. It is used with rigidly fixed PVC piping which may be subjected to thermal cycles. All sizes allow expansion to  $3\frac{1}{2}$  in.

Expansion joint has a neoprene O ring packing. When made with normal impact PVC, the pressure ratings are: 1 in., 205 psi. at 75 F. and 120 psi. at 140 F.; 2 in., 170 psi. at 75 F. and 100 psi. at 140 F.; 3 in., 150 psi. at 75 F. and 90 psi. at 140 F.—Tube Turns Plastics, Inc., Louisville, Ky. 262B

## Line Strainer


**With minimum pressure drop, is self cleaning.**

A recently announced line strainer combines large filtering area with self-cleaning action and minimum pressure drop.

Filter consists of a series of circular, wafer-type elements assembled on a stud and held tightly with a wing nut. Each wafer is flat on one side and somewhat convex on the other. The flat side is covered with the filter medium, the other side is sheet metal.

The assembled stack of wafers is suspended in the strainer body so that the convex metal





## **More Sulphur**

## **More Service**

Freeport has placed in operation four new mines within the past four years and is now working on plans to develop two new deposits. This expansion program has already added one million tons of new annual productive capacity and has substantially increased our known underground reserves of sulphur.

To speed this greater production to customers, we have enlarged and improved facilities at our principal shipping point, Port Sulphur, Louisiana. New equipment and larger dock space now make possible faster loading rates for sulphur, whether in solid or liquid form, for shipment in inland waterway barges or ocean-going vessels.

In addition to the assurance of an uninterrupted flow of sulphur in large quantities, Freeport's customers are offered the help of our Technical Services personnel in solving their sulphur handling and burning problems.

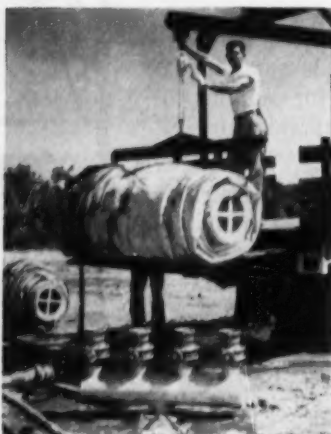
**FREEPORT SULPHUR COMPANY**



surfaces are uppermost. Fluid enters the filter at the top. The diverging entrance passage cuts turbulence, distributing the fluid evenly around the filter.

As the fluid passes downward, momentum carries large dirt to the bottom of the strainer body. As the fluid turns upward below each wafer to pass through the filter medium, heavier particles tend to settle against the convex surface of the wafer below and work outward settling to the bottom. When flow is interrupted, dirt on the filter surfaces tends to drop off, making the filter self cleaning.

Capacities available to 20 gpm. for 1½-in. line. For sumps filter element assemblies are supplied without the case for rates up to 75 gpm.—Ripley Mfg. Co., Crosswell, Mich. 262C



### Collapsible Tanks

Used where transportation hampers tank storage.

The collapsed rubberized nylon tank above holds 15,000 gal. and extends to 45 x 11 x 6 ft. when filled. A built-in pressure-release system prevents rupture of the tank from overfilling.

These tanks were designed for oil, water and other liquids in areas where storage or transportation problems occur. They recently have completed successful tests in the Southwest oil fields where they overcame transportation and storage problems encountered with steel tanks.—Firestone Tire & Rubber Co., Magnolia, Ark. 264A

### Industrial Fans

Embody the latest fan engineering techniques.

Three new fans have been introduced to give the user a choice of wheel designs when considering a given installation.

The radial-blade fan, Type CR, has high-volume, high-pressure characteristics that make lower first cost possible on many applications. Mechanical efficiency is above 78% over a broad range. Fan also handles dust-laden air well.

For Classes II through IV heavy duty industrial air handling (for total pressures above 6½ in. water gage) Type BLH fan offers mechanical efficiency of 86% over a broad range. Such high efficiency is the result of the most complete inlet-to-outlet streamlining ever designed into a fan, it is said.

A new fan with airfoil blades rates 92% mechanical efficiency. Performance tests show exceptionally broad peaks on the mechanical efficiency curve. Three different airfoil wheels and three semi-airfoil wheels are available for various pressure and capacity requirements.—Buffalo Forge Co., 490 Broadway, Buffalo, N. Y. 264B

### Plug Valve

Uses O-ring to seal plug on shutoff without effort.

A new plug valve opens and closes against pressure without effort, yet provides absolute leakproof shutoff. Plug is sealed by ingenious use of O rings.

In the closed position, one O ring on the surface of the plug surrounds the inlet port and provides dead-tight shutoff. In the open position, the valve is full ported to allow a straight-through flow passage. Static O rings at the top and bottom of the plug and around its circumference positively prevent stem leakage.

Valve is made of brass and is available in ½ in. female pipe connections.—Circle Seal Products Co., Inc., 2181 East Foot-hill Blvd., Pasadena 8, Calif.

264C



### Sump Pump

Operates on air, handles good flow at low head.

A new air-operated sump pump is rated at 240 gpm. against a 10-ft. head. Requiring no priming, the pump is ideal for removing water or other liquids from tanks, sumps, ditches, manholes or traps.

Air consumption is low with a ¼-in. air inlet. Available in either steel or bronze, pump weighs 56 lb. or 75 lb. respectively.—Le Roi Div., Westinghouse Air Brake Co., Milwaukee 1, Wis. 264D

### PVC Pipe

Has uniform pressure rating in all sizes.

A new line of light-wall polyvinyl chloride pipe with uniform pressure rating in all sizes has been added to Carpenter's recently announced Schedules 40 and 80 pipe. This new Schedule PR-150 pipe has generally thinner wall and larger inside diameter with resultant higher flow capacity.

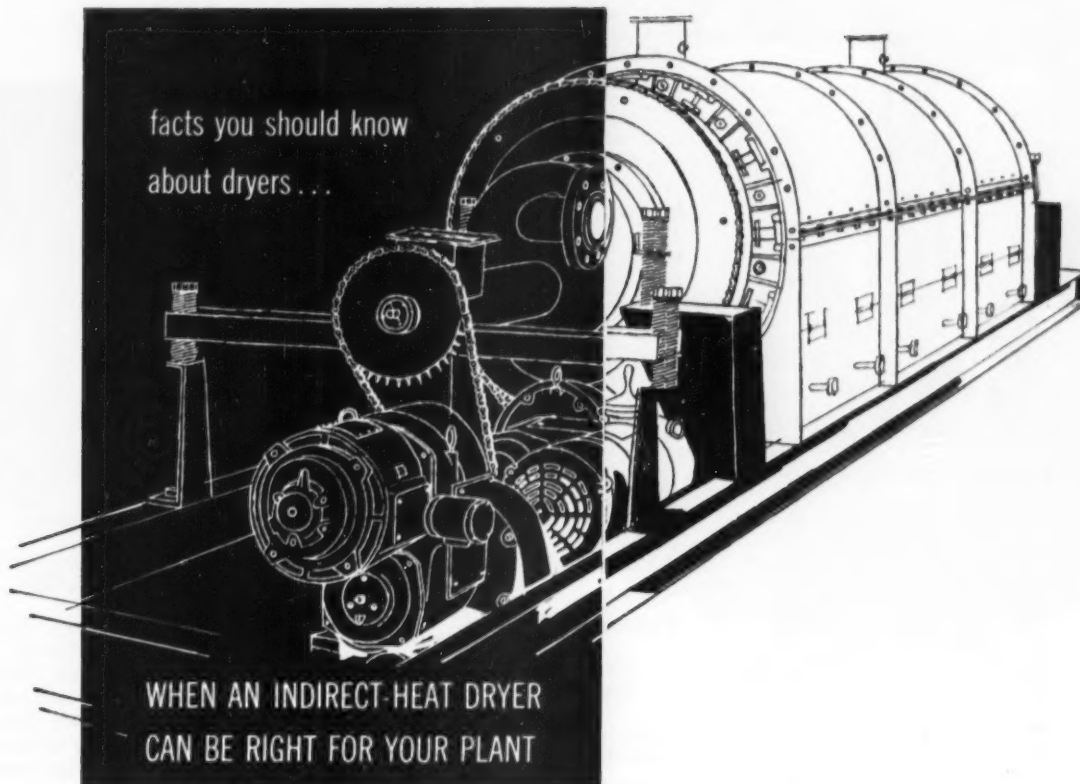
There are two basic types in this series. One has high chemical resistance and a maximum working pressure of 150 psi. at 75 F. The other has high impact strength and a rating of 125 psi. at the same temperature.

This rigid unplasticized pipe is available in eight sizes from ½ to 4 in. Wall thicknesses range between 0.050 and 0.230 in. Standard lengths are 10 and 20 ft.—The Carpenter Steel Co., Alloy Tube Div., Union, N. J.

264E



facts you should know  
about dryers . . .



WHEN AN INDIRECT-HEAT DRYER  
CAN BE RIGHT FOR YOUR PLANT

For over 55 years, Louisville Dryers have been solving industry's drying problems and effecting marked economies. The records of this experience can often be applied to specific cases, possibly yours. For example . . .

**Q.** *My material is a filter cake, practically all minus 325 mesh, and must not contact furnace gases. It can be heated to 500° F. at least, without injury. What type of dryer would do the job best?*

**A.** You might consider using a direct-heat rotary dryer that utilizes clean, heated air as the drying medium—air heated by steam coils or a gas or oil fired heat exchanger. However, this introduces a considerable dust collection problem. Besides, from a standpoint of capacity, it is inefficient as well as from a heat-cost standpoint. This makes it unduly expensive. Therefore, a type of indirect-heat rotary dryer is indicated which would greatly reduce both the

dust problem and the heat cost.

**Q.** *What is meant by an indirect-heat rotary dryer?*

**A.** One in which the material to be dried is warmed by contact with the heated metal surfaces, which in turn are heated by the medium used (usually furnace gases or steam). Those using furnace gases are called "indirect fire dryers". Atmospheric and vacuum drum dryers are examples of steam-heated indirect dryers, but the type in greatest use is the steam tube dryer. This is often referred to as the "Louisville Type" because of the thousands of Louisville Steam Tube Dryers built during the past 55 years.

**Q.** *How does an indirect-heat dryer minimize the dust problem?*

**A.** In an indirect-heat dryer, only enough air is admitted to carry off the evaporated moisture. Thus, the air has nothing to do with the heating

of the material. Generally, this low air velocity results in insignificant dust loss.

**Q.** *How does this differ from the operation of a direct-heat dryer?*

**A.** In direct-heat dryers, the hot air furnishes the heat for drying besides removing the evaporated moisture. The amount needed to supply the necessary heat results in a sufficiently high velocity through the dryer to carry out an excessive amount of fine material particles.

**Q.** *It seems I need an indirect-heat dryer. How can I get competent advice and more information regarding my particular requirements?*

**A.** The Louisville Dryer engineering staff will be glad to analyze your requirements, arrange for necessary pilot plant tests, and submit an unbiased recommendation accompanied by estimated costs. You incur no obligation by using this service.



LOUISVILLE DRYING MACHINERY UNIT

**GENERAL AMERICAN TRANSPORTATION CORPORATION**

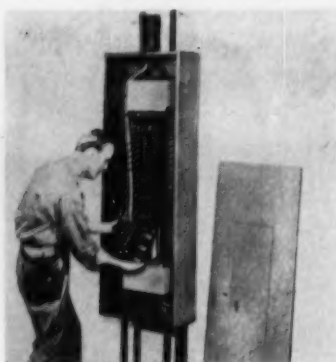
*Dryer General Sales Office: 139 So. Fourth Street, Louisville 2, Kentucky*

*Eastern Sales Office: 380 Madison Avenue, New York 17, New York*

*In Canada: Canadian Locomotive Company, Ltd., Kingston, Ontario, Canada*

*General Offices: 135 S. La Salle Street, Chicago 90, Illinois*





### Circuit Breakers

Low initial and maintenance cost, long life.

The StABreaker line is believed to provide an entirely new plug-in type of AB industrial circuit-breaker panel-board technique that conforms to industry-wide standards. The new Type E, F and J frame breakers provide plug-in ratings from 15 to 225 amp. in only two NEMA 1A general purpose enclosures. Two additional enclosures for conventional bolted-in Type K, KL and L frame breakers complete the line.

Advantages include: visible disconnect safety; minimum down time because they can carry temporary light overloads; long service life due to quick-make and quick-break mechanism with deionization type of arc quenching; accurate, tamperproof calibration; positive motor protection; and low watts-loss by elimination of high-resistance riveted and bolted joints.—Federal Pacific Electric Co., Newark, N. J. 266A

### Speed Reducer Pulley

Designed to give differential driving action.

A new differential speed reducer pulley consists of a V-belt pulley having an internal gear reduction ranging up to 8,000 to 1. Also, it has a torque disk designed for driving through a separate control motor to provide differential action.

In the standard reduction pulley, this torque disk and attached held gear are in a fixed position. As the pulley revolves around the held gear, reduction is obtained through the internal planetary gear train. Driving this torque disk and held gear by means of an attached sprocket provides differential action at any desired controlled speed.

It can be arranged for either chain or V-belt drive and can be driven in either direction. Shaft mounted, it requires no mounting brackets or bearings. —Hart Reduction Pulley Co., 426 West Main St., Waukesha, Wis. 266B

### Transistors

Now proven to have exceptionally long lives.

Replacement of transistors in portable radios and other electronic equipment may never be necessary if they are used within the limits set by the manufacturer.

At G.E., life tests started in 1954 on random samples from regular manufacturing lots show no failures after 18,000 hr. working at full load. They may never fail because they look and act like new transistors.

Several lots of transistors were shot from a mortar which is equivalent to a shock of 8,000 g. Out of the total group 60-75% of the transistors could still operate at full power.

Further, transistors can withstand substantial doses of nuclear radiation. Also germanium transistors can operate at 100 C. and can be stored at 135 C.—General Electric Co., Semiconductor Products, Electronics Pk., Syracuse, N. Y. 266C



### Vertical Gearmotors

For heavy-duty fan drives in cooling towers.

A new line of vertical, shaft-up gearmotors is offered to replace present cooling tower fan drives that use a separate right-angle speed reducer driven by a horizontal motor through a floating, flexible-coupled shaft.

With the new drives, only one supporting structure is necessary. Gears and bearings are supported in a rugged one-piece cast-iron housing.

Type U gearmotors are available in ratings from 15 to 75 hp. with motor speeds of 1,150 and 1,750 rpm. Output speeds vary from 170 to 780 rpm.—Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa. 266D

### Equipment Cost Indexes

	June 1956	Sept. 1956
<b>Industry</b>		
Avg. of all.....	204.2	211.3
<b>Process Industries</b>		
Cement mfg. ....	194.8	201.6
Chemical .....	204.3	211.5
Clay products .....	189.2	195.8
Glass mfg. ....	193.0	199.8
Paint mfg. ....	196.6	203.5
Paper mfg. ....	196.9	203.8
Petroleum ind. ....	200.7	207.7
Rubber ind. ....	203.2	210.3
Process ind. avg. ....	201.4	209.0
<b>Related Industries</b>		
Elec. power equip. ....	206.2	213.4
Mining, milling .....	205.6	212.8
Refrigerating .....	229.0	237.3
Steam power .....	192.5	199.2

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1956, pp. 194-5 for annual averages since 1913.

### For More Information...



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.





## A GOOD MAN TO KNOW FOR INDUSTRIAL LUBRICATION

No service is better than the men behind it. That's why Atlantic lubrication consultants, such as the man you see in the illustration, are experienced men with years of on-the-job knowledge of heavy industrial lubrication requirements.

These men are also representative of the men behind the service you can expect from Atlantic. Atlantic is made up of many specialists — men skilled in research, production, transportation and marketing of petroleum products from lubricants and gasolines to petrochemicals.

Behind their skills are 85 years of developing successful products for the use of our customers. Atlantic has pioneered in many historic firsts in

the petroleum industry. To judge for yourself the value of Atlantic service, write, wire or phone the Atlantic office nearest you for full information on Atlantic lubricants for heavy industrial installation. The Atlantic Refining Company, Dept. W-12, 260 South Broad Street, Philadelphia 1, Pa.

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Chamber of Commerce Bldg.



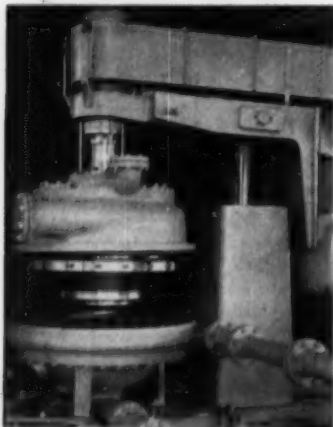
## Dryer-Blender

Glassed-steel vacuum unit in larger size.

A new 8-ft. glassed steel conical dryer-blender is a larger version of one introduced last year by Pfaudler. Unit is suitable for plastics, chemicals, dye stuffs and pharmaceuticals.

Dryer can be used for every acid except hydrofluoric and for alkalis up to pH 12 at 212 F. Internal pressures can range from full vacuum to 20 psi.

As the dryer rotates, hot water or steam is circulated through the jacket. Vacuum exhaust removes the vapors. Moisture content of the charge can be lowered to 0.01%—The Pfaudler Co., Rochester, N. Y. 268A



## Pressure Centrifuge

Operates continuously at high process pressure.

Announced as the first centrifugal separator to operate continuously at elevated temperatures and pressures, the new Merco pressure centrifuge covers the same range of separations as other Merco centrifuges. This high-speed, bowl-type unit operates up to 100 psi. and 330 F., can cut processing time by eliminating cooling and pressure reduction prior to centrifuging.

Most important of the new design features is a housing closure which seals in high internal operating pressures. The closure allows the shaft to deflect normally during rotation

without venting any internal pressure.

First job handled by the pressure centrifuge has been to remove abrasive, clay-type particles from a solution of polyethylene in hydrocarbon solvent. It is adaptable to any high-pressure, high or low temperature processing step.

Centrifuge is available in the PC-9 laboratory or pilot-plant model and PC-30 production model. The smaller unit handles 1-20 gpm. at centrifugal forces up 9,500 g.; the larger has capacity for 90-250 gpm. up to 4,000 gpm.—Dorr-Oliver, Inc., Barry Pl., Stamford, Conn. 268B

## Impact Mill

Large 40-in. machine for extremely high capacities and impact velocities.

The latest model of the Entoleter impact mill and centrifugal mixer is a 40-in. machine that produces impact velocities well above 30,000 ft. per min. This means impact forces are 2.25 times those attained previously with 27-in. unit.

Particle size reduction has been extended with this machine to materials that couldn't be handled with this type of equipment previously. Among the first jobs being handled with the unit are pulverization of coal and phosphate rock, fiberizing of asbestos.

Machine can accommodate constant-speed motors up to 125 hp. and Varidrive to 60 hp. Stainless steel and abrasion-resistant construction can be furnished.—Entoleter Div., Safety Industries, Inc., P. O. Box 904, New Haven 4, Conn. 268C

## Vacuum Dryer

Dries many materials rapidly and gently.

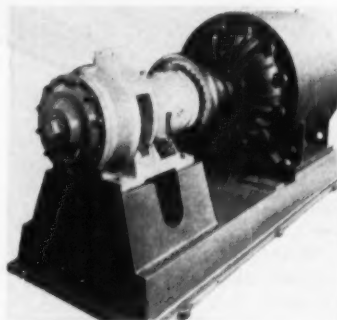
The new Rota-Cone vacuum dryer is said to use a new combination of principles for rapid, thorough and gentle drying of a broad range of materials.

During the drying cycle the Rota-Cone rotates continuously

to expose all particles evenly to drying action from the cone walls and hot atmosphere. Particles are mixed intimately without abrading or size reduction.

Vapor-laden air is removed under vacuum which holds drying temperatures low. Operation is completely dustless.

Standard equipment includes insulated heating jacket, integrally mounted variable-speed drive and mounting stand. A circulating oil heater is optional. Unit available in steel, stainless steel, aluminum, Monel and bronze for charges from 1 to 325 cu. ft.—Paul O. Abbe, Inc., 375 Center Ave., Little Falls, N. J. 268D



## Colloid Mill

Has 20-40% more capacity than previous models.

New design features on the Charlotte colloid mill are said to boost production capacities on lubricating greases, asphalt, and tar emulsions, wood pulp binders, clay coatings, etc.

The colloid mill is fed and discharged under constant pressure to eliminate aeration of the product being handled. The distinctive grooving on stator and rotor produces stable emulsions and fine dispersions.

Machine has a front-end removable shaft seal which simplifies maintenance and adjustment. Oversize radial and thrust bearings support the rugged shaft at 3,600 rpm. The large unit is powered by 125 hp. motor to handle viscous materials up to 25,000 lb. per hr. and less viscous materials to 50,000 lb. per hr.—Chemicolloid Laboratories, Inc., 55 Herricks Rd., Garden City Park, N. Y. 268E

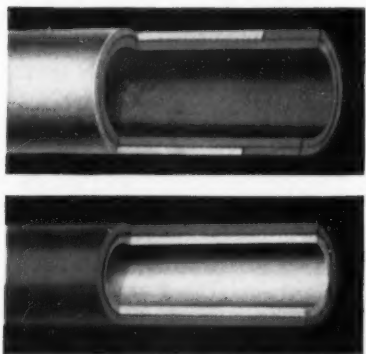




## CONDENSER TUBE CLINIC

THE AMERICAN BRASS COMPANY  
WATERBURY 20, CONNECTICUT

### How two-tubes-in-one can help you solve complex corrosion problems



Edited by James T. Kemp, Metallurgical Engineer

**TWO SEPARATE CORROSION PROBLEMS.** A Duplex Tube of steel with copper or a copper alloy inside is used, for example, in exchangers or condensers handling water in the tubes and ammonia or a fluid with appreciable amounts of ammonia in the shell. Moist ammonia attacks copper and all of its alloys, and may cause stress-corrosion cracking. Stresses may be due to applied loads or may be residual from cold working of the metal. Steel, however, is not susceptible to such action by ammonia. Thus the nonferrous tube is shielded and can perform its normal function of giving long service life and efficient heat transfer on the "water side."

Other combinations of coolant—or heating fluid—and "stream" are found in petroleum refineries and chemical plants, in which differing properties are required inside and outside an exchanger tube. Here two nonferrous metals may be combined—a Cupro Nickel and Admiralty, for example.

**HEAT TRANSFER.** Duplex Tubes have thermal transfer characteristics somewhere between those of the two metals used. Each face of the tube has the receptivity-emissivity of its metal. The

metal-to-metal interface is so intimate it offers little resistance to heat flow.

**FERRULES.** Duplex Tubes can be supplied with ferrules of the same composition as the inner tube (see upper illustration), replacing a short section cut from the end of the outer tube. This ferrule prevents excess corrosion of the ends exposed in the exchanger channel. The ferrule should be long enough to be securely rolled in when the Duplex Tube is expanded into the tube sheet.

**TECHNICAL ASSISTANCE.** The American Brass Company's metallurgical engineers and its sales representatives throughout the country are available to help you in the selection of the Anaconda Condenser Tubes to meet your problems. Write: Technical Department, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

**ANACONDA®**  
Tubes and Plates  
for Condensers  
and Heat Exchangers

PHYSICAL PROPERTIES OF ANACONDA CONDENSER TUBES\*

ALLOY	Tensile Strength, psi	Yield Strength at .5% Elongation Under Load, psi	Elongation in 2", %	Rockwell Hardness, B Scale	Density, lb. per Cu. In.	Thermal Conductivity, B.T.U./Sq. Ft./In./Hr./°F. at 68° F.	Average Coefficient of Linear Thermal Expansion per °F. (77-572 F.)
Arsenical Admiralty-439	52,000	22,000	60	4-4.5	0.308	768	.0000112
Ambraloy-927	60,000	27,000	55	35-65	0.301	696	.0000108
Ambraloy-901	60,000	30,000	60	30-60	0.295	552	.0000099
Cupro Nickel, 30%-702	55,000	22,000	50	30-60	0.323	204	.0000090
Cupro-Nickel, 10%-755							
Light Annealed	44,000	22,000	46	25	0.323	314	.0000093
Light Drawn	60,000	57,000	15	68			
Red Brass-24	42,000	15,000	50	0-30	0.316	1104	.0000104
Ambronze-421	46,000	20,000	55	0-30	0.316	830	.0000102
Phosphorized Arsenical Copper-108							
Light Drawn	40,000	35,000	20	20-50	0.323	1344	.0000098
Hard Drawn	54,000	50,000	8	50-70			
Phosphorized Copper-103							
Light Drawn	40,000	35,000	20	20-50	0.323	2364	.0000098
Hard Drawn	54,000	50,000	8	50-70			

Note: The above values are approximate and should not be used for specification purposes. \*Light annealed except as noted.



# BRIEFS FOR BUYERS

## about . . . Caustic Soda



### New engineering guide helps you handle caustic soda safely

This 40-page Hooker manual helps you handle and store liquid caustic soda safely, efficiently, and with minimum risk of contamination.

Its contents include large, detailed diagrams of equipment; a section on materials of construction; recommendations for unloading, diluting, piping, and storage; and a section on safety precautions and first aid.

Eighteen graphs, charts, tables help you predict and control the behavior of liquid caustic soda under a wide range of operating conditions.

For a copy, check the coupon for Hooker Bulletin 102, *Caustic Soda Engineering and Handling Guide*.

### Another bulletin—for buyers



Hooker Bulletin 101 is also replete with useful information on caustic soda. But this one is edited especially for the buyer.

It is pocket-sized for ready reference. Besides data on the forms and grades of Hooker caustic soda, its contents include a list of the advantages of 50% versus 73% liquid solutions and *vice versa*; comparative costs; capacities of tank cars and other containers; useful shipping information.

For a copy, check the coupon for the *Caustic Soda Buyer's Guide*.

### New caustic soda drum empties faster

Whether your operators scoop, pour, or shovel caustic soda from drums, they'll find our new drums easier, faster, and safer to work with.

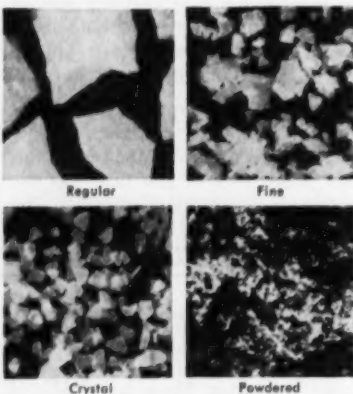
The lids on these drums have been increased from 14 to 18 inches in diameter—an increase of 65% in opening area.

You pay no extra for this new drum. So, if you've been paying a premium to get full open-head drums, you can now get many of the advantages of a larger opening at standard prices.

One thing you *won't* find changed on the Hooker drum is the lid seal. Six sturdy lugs grip the lid tightly to protect both contents and handlers.

Something else that has not changed is the quality of the caustic soda going into the drums.

You still have a choice of four flake sizes, shown actual size:

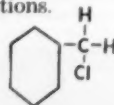


*Regular, Fine, and Crystal* are non-dusting and have uniform thickness. You can order the new drum in 400- and 450-pound sizes. Our 100-pound drum has a 10-inch opening.

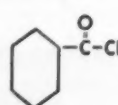
### Four versatile chloro aromatics

These Hooker aromatic compounds give you easy, practical ways of putting benzyl, benzoyl, and nitroben-

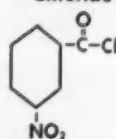
zoyl groups into organic compounds, particularly through Friedel-Crafts reactions.



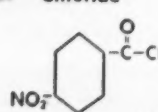
**Benzyl Chloride**



**Benzoyl Chloride**



**m-Nitrobenzoyl Chloride**



**p-Nitrobenzoyl Chloride**

Each of these compounds will undergo other reactions to produce useful products.

All four compounds are high-quality chemicals. On two of them—*meta*- and *para*-nitrobenzoyl chloride—Hooker is the only brand available in commercial quantities.

You can order as little as a 5-gallon container of these compounds, or as much as a carload.

If you'd like to know more about the specifications and physical and chemical properties of these compounds, check the coupon for technical data sheets.

### Fast way to make up solutions of muriatic acid

A check mark on the coupon will bring you a technical data sheet that shows at a glance how much Hooker muriatic acid you need to make up various volumes of solutions of different strengths.

The same sheet gives some advice on the safe handling of muriatic acid, and the specifications of Hooker muriatic.

Even a quick glance at the specs is likely to convince you that the purest muriatic you can buy anywhere in volume is "Hooker White"



# • Chlorinated Aromatics • Muriatic Acid *para*-Dichlorobenzene • Chlorinated Solvents

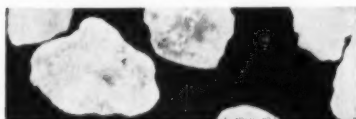
grade. Entirely free of arsenic and free chlorine, this grade contains no more than .003% sulfates, .0001% iron.

You'll discover that our commercial grade is only slightly less pure: iron, .0005%; free chlorine, a trace; sulfates, .003%; organic matter, .001%; arsenic, not a jot.

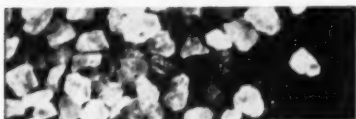
Both grades are available for your use in 13-gallon glass carboys and in rubber-lined tank cars in 18°, 20°, and 22° Baumé.

## PARADI®—seeing is believing is using

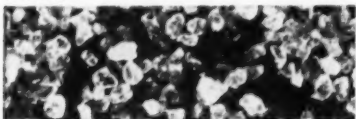
Some of our Missourian customers like to see the six different sizes of



PEA NO. 1



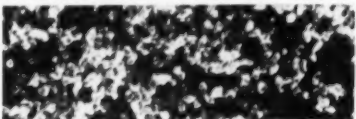
PEA NO. 2



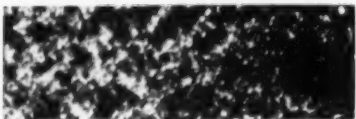
RICE NO. 1



RICE NO. 2



RICE NO. 3



POWDERED

*para*-dichlorobenzene they can get when they buy from Hooker.

Hence the strips here, showing all six actual size. All six are 100% pure *para*. They're dry, non-oily; they sublime completely.

Check the coupon for a data sheet that lists complete specifications on all six sizes.

## Now you can get five different chlorinated solvents from Hooker

All five of the following solvents are completely miscible with acetone, benzol, butanol, carbon tetrachloride, diethyl ether, ethylene dichloride, linseed oil, methanol, petroleum ether, Solvesso No. 2.

None are classified as flammable under ICC regulations.

### ortho-Dichlorobenzene

Freezing pt.: -18° to -22°C.  
Distillation range: 4°C. inc. 179.5°C.  
Specific gravity (15.5°/15.5°C.): 1.313

### Monochlorobenzene

Freezing pt.: -44°C.  
Distillation range: 1°C. inc. 132°C.  
Specific gravity (15.5°/15.5°C.): 1.113

### Monochlorotoluene

Freezing pt.: below -45°C.  
Distillation range: 158.3°C. to 161.7°C.  
Specific gravity (15.5°/15.5°C.): 1.080

### Trichlorobenzene

Freezing pt.: 10°C. Max.  
Distillation range: 5°C. Max. inc. 216°C.  
Specific gravity (15.5°/15.5°C.): 1.466

### Nialk® Trichlorethylene

Freezing pt.: -86.4°C.  
Distillation range: 86.6°C. to 87.8°C.  
Specific gravity (15°/4°C.): 1.469

*Cyclohexanol and Methyl Cyclohexanol: You can also get these hydrogenated solvents from Hooker in large or small quantities.*

If you would like specifications and other data on these Hooker solvents, please check the coupon.

## HOOKEE ELECTROCHEMICAL COMPANY

512 Forty-seventh Street, Niagara Falls, N. Y.

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES



663W12

For more information on chemicals mentioned here, check below:

- ☐ Caustic Soda Engineering and Handling Guide, Bulletin 102
- ☐ Caustic Soda Buyer's Guide, Bulletin 101

Data sheets:

- ☐ Caustic Soda
- ☐ Benzoyl Chloride
- ☐ Benzyl Chloride
- ☐ meta-Nitrobenzoyl Chloride
- ☐ para-Nitrobenzoyl Chloride
- ☐ Muriatic Acid

- ☐ *para*-Dichlorobenzene
- ☐ ortho-Dichlorobenzene
- ☐ Monochlorobenzene
- ☐ Monochlorotoluene
- ☐ Trichlorobenzene
- ☐ NIALK Trichlorethylene
- ☐ Cyclohexanol
- ☐ Methyl Cyclohexanol

Clip and mail to us with your name, title, company address. When requesting samples, please use business letterhead to help speed delivery.



# Chemical Economics

EDITED BY D. R. CANNON

## How the chemical process industries spend their equipment dollars...

(Million Dollars)

WHO...		WHAT...	
Chemicals	476.4	187.5	Materials Handling
Coke and Byproducts	8.3	445.8	Liquid, Gas and Air Handling
Drugs and Medicines	46.7	42.8	Disintegration
Explosives and Fireworks	10.1	28.0	Mixing
Fertilizers	41.9	46.8	Chemical Reaction
Glass and Ceramics	286.3	114.4	Heat Transfer and Tower
Leather	12.4	29.2	Dry Separation
Lime and Cement	29.7	5.0	Wet Separation
Metallurgical and Metal Products	6.4	10.0	Dryers and Kilns
Oils and Fats	61.8	49.1	Air Conditioning and Refrigeration
Paints, Varnishes, Pigments	42.4	59.1	Power Transmission
Paper, Pulp and Board	222.1	90.3	Steam and Power Generating
Petroleum Products	390.6	3.8	Lubrication
Plastics Materials	25.5	162.7	Electrical
Synthetic Fibers	70.3	94.2	Measurement and Control
Rubber Products	68.7	16.3	Coating, Forming, Agglomerating
Soap, Glycerin, Cleaning, etc.	20.5	422.7	Construction Materials (for equipment)
Other Chemically Processed Products	144.8	215.8	Plant Construction, Auxiliary Service
	2,124.9		2,124.9

2 BILLION DOLLARS

## WHERE...



## How Much for Equipment?

In a survey pinpointing an enormous market, 18 segments of the chemical processing industries tell how much they spend for 230 kinds of equipment.

How much do chemical manufacturers spend for platform slat, apron and pan conveyors in a year's time? How much does the drugs and medicines industry lay out for diaphragm valves? How much is spent in a year on dust collectors, air fil-

ters and electrostatic separators by chemical processing plants in the West South Central section of the U.S.?

These are data you could really get your teeth into if you had them, solid, practical—and hard to come by. They're available

now in a survey put together for Chemical Engineering and Chemical Week.

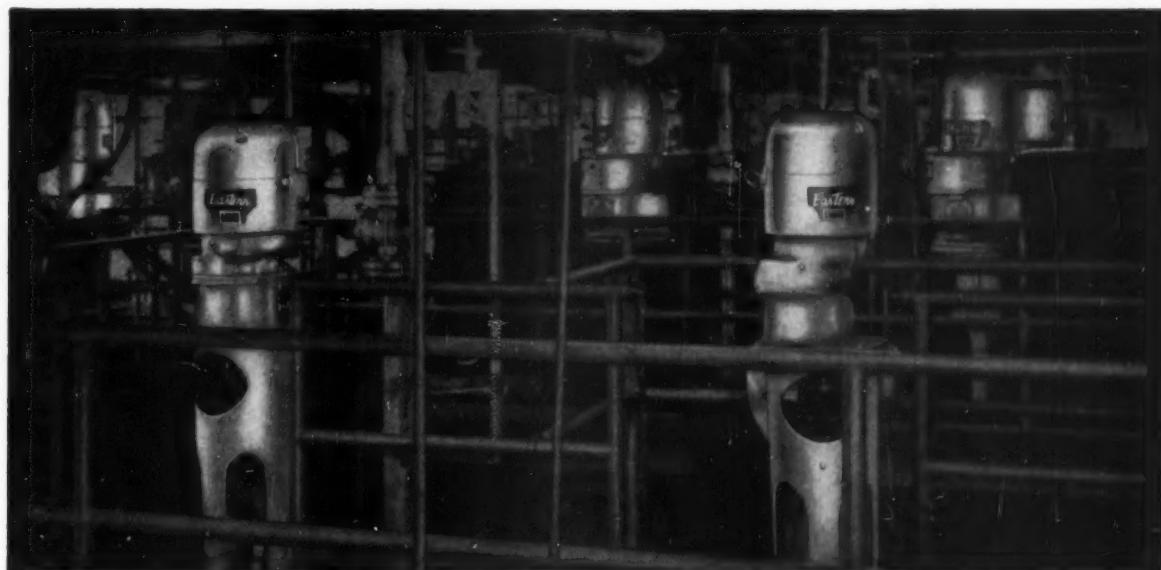
CE and CW, in conjunction with McGraw-Hill's Research Dept., combed the chemical process industries via field interview and mail questionnaire—to find out how much each segment shelled out in a year's time for each of some 230 different process equipment items, ranging from thermometers to prefabricated buildings.

When the huge question-and-answer job was finished the surveyors had reports garnered from nearly 2,500 manufacturing plants in the CPI with more than 20 employees. These they sorted and projected until they had a profile of the equipment bill for 230 kinds of equipment for all 18 segments of the CPI as well as nine U. S. areas.

In this month's CE story we've listed expenditures only for major categories (e.g. Liquid, Gas and Air Handling Equipment) and minor categories (e.g. Pumps). The complete survey report goes further to include items like reciprocating pumps, diaphragm pumps, rotary pumps, etc.

For details of the survey, contact Adolph Losick, Research Director, Chemical Engineering-Chemical Week.





Back in 1942 the new synthetic rubber program was of urgent importance to the war effort. Naugatuck Chemical Co., now a Division of U.S. Rubber Co., developed processes that included fluid mixing applications. Many of Naugatuck's top-entering and portable mixers were engineered and manufactured by Eastern Industries specifically for these processes.

After fourteen years of hard, continuous service, these Eastern Mixers continue proving their built-in reliability.

If you have a process entailing critical operating conditions, get a long-term guarantee on your investment by selecting durable Eastern Mixers. Eastern offers engineering assistance in the selection of proper mixers from the complete Eastern line.

**CONTINUOUS  
SERVICE . . .**

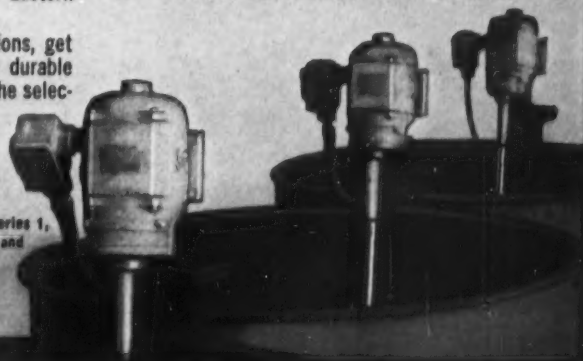
**14 YEARS**

**Eastern**



**INDUSTRIES, INC.**  
Mixer Division  
Regent Street  
Norwalk, Conn.

Write for Catalog Series 1,  
containing product and  
engineering data.



### PORTABLE MIXERS

Various models offer a choice of speeds and H.P. dependent upon the consistencies of fluids. All models are available with shafts and propellers of various alloys. Single and dual propellers, and a wide choice of motors give flexibility to handle the most critical of operating conditions.



### TOP & SIDE ENTERING MIXERS

Heavy-duty models cover the range from  $\frac{1}{4}$  to 30 H.P., at speeds from 280 to 1725 R.P.M. Versatile in design . . . rugged in performance, these mixers offer a wide choice in mounting arrangements and motors. All side entering models are available with stuffing boxes which can be repacked with a full tank.



### TURBINE MIXERS

Many of the Eastern Turbine applications include blending, dissolving and heat transfer. A variety of motor mounts and stuffing boxes available within a H.P. range of  $\frac{1}{4}$  to 40, add flexibility to the Eastern line.



## Where the \$2 Billion Goes . . .

(Million dollars)

WHAT . . .	WHO . . .	Total CPI	Chemicals	Coke, Byproducts	Drugs	Explosives	Fertilizers	Glass, Ceramics	Leather	Lime & Cement	Metallurgical	Oils & Fats	Paints	Paper & Pulp	Petroleum	Plastics	Synth. Fibers	Rubber Prod.	Cleaning Prod.	Others
Materials Handling		187.5	32.1	0.1	3.6	1.3	7.7	32.5	1.7	16.9	7.4	10.3	4.9	18.1	11.8	1.7	7.3	10.0	4.0	15.1
Unit goods conveyors		18.7	1.7	*	0.5	0.1	0.7	2.5	0.1	0.9	0.6	1.8	0.3	3.5	0.4	*	0.8	2.5	0.5	1.5
Pan, belt & bucket conveyors		24.2	5.1	0.3	0.3	0.2	2.2	3.5	0.3	3.6	0.6	1.5	0.3	0.8	0.3	0.1	0.7	1.9	0.5	2.1
Other types of conveyors		14.8	2.8	*	0.1	0.1	0.5	1.5	*	2.6	0.1	2.5	0.2	1.4	0.2	*	0.9	0.1	0.7	1.2
Overhead equipment		24.0	2.8	0.3	0.2	0.1	0.2	4.6	0.1	1.3	4.0	0.4	0.5	2.5	0.8	0.1	2.8	1.7	0.2	1.3
Hand-operated trucks		5.3	0.7	*	0.5	*	0.1	1.1	0.2	0.1	0.1	0.2	0.2	0.4	0.4	0.1	0.1	0.5	0.3	0.5
Power-operated trucks		55.4	7.4	0.3	1.6	0.6	2.1	12.3	0.7	4.7	1.4	1.9	1.6	7.8	3.0	0.4	1.7	2.2	0.8	4.7
Miscellaneous		45.4	11.7	0.1	0.6	0.1	1.9	7.1	0.3	3.8	0.6	2.0	1.8	1.7	6.7	0.9	0.4	1.0	1.1	3.7
Liquid, Gas & Air Handling		445.8	127.4	3.2	8.9	1.8	8.2	29.2	2.1	4.0	6.1	10.3	6.8	22.0	167.7	5.7	14.8	8.8	3.5	15.3
Pumps		53.8	20.0	0.5	1.0	0.1	1.7	2.2	0.3	0.7	0.3	1.9	1.4	4.0	13.6	0.4	2.2	0.9	0.6	2.1
Gas and air handling		44.6	16.8	0.1	1.6	0.2	0.7	5.4	0.4	1.1	0.7	1.0	0.4	2.8	1.9	0.3	1.8	1.5	0.2	1.7
Valves		65.4	28.1	0.9	1.2	0.3	2.4	3.2	0.4	0.7	1.1	1.4	1.0	4.3	12.8	1.1	1.0	1.7	0.6	3.1
Piping, fittings and hose		153.0	41.1	1.1	3.8	0.8	1.5	12.1	0.8	1.3	3.8	2.7	2.6	8.0	52.9	3.4	6.8	3.4	1.0	5.8
Miscellaneous		129.0	21.3	0.7	1.3	0.3	1.8	6.3	0.2	0.2	0.1	3.3	1.4	2.8	80.6	0.5	3.0	1.4	1.1	2.5
Disintegration		42.8	14.4	*	0.4	0.1	0.4	4.1	*	17.7	0.1	0.6	2.0	0.3	0.2	0.2	0.4	0.9	0.2	0.8
Crushers		15.7	12.3	*	*	*	*	0.5	*	2.2	0.1	0.1	*	*	*	0.1	*	0.1	*	0.3
Mills, grinders, shredders		27.1	2.1	*	0.3	0.1	0.4	3.6	*	15.5	*	0.5	2.0	0.3	0.2	0.1	0.4	0.8	0.2	0.5
Mixing		28.0	5.3	*	1.4	0.2	1.8	2.8	0.1	0.4	0.3	1.0	1.5	2.6	1.3	0.4	4.1	2.6	0.6	1.6
Chemical Reaction		46.8	22.0	0.4	3.5	*	0.2	0.3	*	*	0.1	1.0	2.0	0.4	13.4	0.2	0.8	0.1	0.7	1.4
Agitated vessels		25.4	17.5	*	2.2	0.1	*	0.2	*	*	*	0.9	1.7	0.3	0.6	0.1	0.4	0.1	0.4	1.0
Unagitated vessels		21.5	4.6	0.4	1.3	*	0.2	0.1	*	*	0.1	0.2	0.4	0.1	12.8	*	0.4	*	0.4	0.4
Heat Transfer, and Tower		114.4	41.6	0.2	2.5	0.3	1.6	3.4	0.2	0.8	0.2	3.3	2.0	4.2	47.6	0.9	0.9	1.1	0.4	3.4
Tower equipment		40.6	21.8	0.1	0.8	0.1	0.9	0.8	*	*	0.1	1.5	0.5	0.6	12.2	0.4	0.4	*	*	0.4
Evaporators		5.3	2.5	*	0.1	*	*	0.3	*	*	*	*	0.2	0.5	*	*	*	*	*	1.4
Heat transfer equipment		68.5	17.3	0.1	1.6	0.2	0.7	2.2	0.2	0.8	*	1.8	1.3	3.0	35.3	0.5	0.5	1.0	0.3	1.6
Dry Separation		29.2	6.0	0.1	0.6	0.2	1.4	5.2	0.1	5.9	1.6	0.9	0.6	1.7	2.4	0.2	0.4	0.5	0.1	1.4
Wet Separation		37.0	6.4	*	2.1	*	1.2	3.2	*	0.3	0.7	1.5	2.4	5.3	2.0	0.6	1.4	0.4	0.1	8.8
Filtration		16.5	3.3	*	1.2	*	0.8	0.6	*	*	0.2	0.9	1.4	2.0	1.6	0.5	1.9	*	0.1	1.7
Classification		4.2	0.5	*	*	*	0.1	0.3	*	0.2	0.1	*	0.1	1.7	*	*	*	*	*	1.1
Other types		16.2	2.6	*	0.8	*	0.4	3.2	*	*	0.3	0.6	1.0	1.6	0.4	*	*	0.4	*	6.0
Dryers and Kilns		79.4	8.4	0.1	0.8	*	2.6	26.7	0.5	20.4	1.3	0.8	1.4	5.3	0.1	0.2	2.2	2.9	0.4	5.4
Dryers		32.3	1.9	*	0.8	*	2.2	8.5	0.5	0.8	0.2	0.8	0.9	5.3	*	0.2	2.2	2.7	0.4	5.1
Kilns and furnaces		47.1	6.6	0.1	0.1	*	0.4	18.3	*	19.5	0.1	*	0.5	*	0.1	*	0.1	*	0.4	0.4
Air Conditioning, Refrigeration		49.1	7.4	0.1	3.8	0.1	0.3	6.2	0.4	0.2	2.3	0.4	0.8	8.2	10.5	0.8	3.5	2.0	0.5	1.4
Power Transmission		59.1	8.8	0.1	0.6	0.3	1.8	15.9	1.0	2.7	1.0	1.7	1.1	11.4	2.0	1.3	1.8	2.5	0.4	4.7
Steam and Power Generating		90.3	13.0	0.4	0.8	0.5	0.7	10.1	0.1	2.0	1.1	0.9	0.9	24.5	24.5	0.5	*	3.4	0.1	6.9
Engines (I.C.), gas turbines		8.7	1.1	0.4	0.1	0.2	0.2	1.0	*	0.8	0.7	0.3	*	0.4	3.3	*	*	0.1	*	0.2
Burners		21.8	0.8	*	0.4	*	0.3	2.9	0.1	0.4	0.4	0.2	0.3	7.2	0.9	*	*	1.8	*	5.8
Steam producing equipment		49.1	7.3	*	0.2	0.2	0.3	6.1	*	0.7	0.1	0.2	0.5	14.6	16.0	0.4	*	1.5	*	0.8
Steam power mechanisms		10.7	3.8	*	0.1	*	*	*	*	*	*	0.2	*	2.2	4.2	0.1	*	*	*	0.1
Lubrication		3.8	0.3	*	*	*	0.1	0.7	*	0.2	0.1	0.1	0.1	0.6	1.1	*	0.1	0.3	*	0.1
Electrical		162.7	28.8	0.6	2.1	1.5	2.2	23.7	1.3	17.4	2.9	7.5	3.0	22.5	17.0	2.9	7.8	11.3	1.0	9.1
Motors		47.2	7.8	0.4	0.4	0.2	0.8	6.5	0.4	4.0	0.6	1.5	1.1	9.5	5.5	0.8	1.8	2.7	0.4	2.7
Transformers, distribution		39.7	9.2	0.1	0.4	0.4	0.3	4.8	0.3	7.6	0.5	0.8	0.5	4.8	4.1	1.1	1.9	1.8	0.1	1.1
Lamps and lighting		24.7	5.5	0.1	0.7	0.6	0.4	2.9	0.3	1.3	0.7	1.6	0.8	2.4	1.5	0.4	1.8	2.3	0.2	1.4
Switchgear		31.8	4.3	*	0.5	0.1	0.8	3.9	0.3	4.0	0.8	3.3	0.5	4.5	3.1	0.3	1.2	2.8	0.2	1.2
Electrical heating		4.5	0.1	*	*	*	*	3.2	*	*	0.1	*	*	0.2	*	0.2	0.1	0.3	*	0.2
Conversion equipment		2.4	0.1	*	*	*	*	0.5	*	*	*	*	0.1	0.4	0.4	0.1	*	0.3	*	0.3
Generators		12.4	1.7	*	*	*	*	2.0	*	0.4	0.2	0.1	0.1	0.7	2.4	*	1.1	1.1	*	2.3
Measurement & Control		94.2	22.6	0.3	1.7	0.9	2.5	10.8	0.3	2.1	0.6	9.2	1.6	7.6	16.0	2.1	6.3	2.9	1.3	5.4
Pressure		22.0	6.3	*	0.3	0.4	0.2	1.5	*	0.3	0.1	0.7	0.4	1.5	4.9	0.9	2.8	0.7	0.1	0.8
Temperature		26.5	9.5	0.1	0.5	0.2	0.6	5.4	0.1	0.3	0.2	6.5	0.6	1.8	6.8	0.8	2.1	1.2	0.2	1.6
Flow measuring		8.7	3.0	*	0.1	*	0.3	0.4	*	*	0.1	1.2	0.2	0.5	2.1	0.1	0.2	0.1	*	0.3
Liquid level measuring		3.0	0.8	*	0.1	*	0.1	0.4	*	*	*	0.1	0.1	0.3	0.6	0.1	0.2	*	*	0.2
Weighing and proportioning		18.4	2.8	0.1	0.3	0.2	1.5	2.0	0.1	1.3	0.2	1.1	0.4	2.5	1.6	0.3	1.0	0.5	0.9	1.6
Composition and consistency		5.9	1.4	*	0.3	*	*	0.4	*	0.1	*	0.1	*	0.3	2.0	*	*	0.1	*	0.2
Electrical measuring		4.0	0.8	*	0.1	*	*	0.4	*	0.1	*	0.6	*	1.0	0.3	*	0.1	0.2	*	0.3
Final control elements		5.4	1.2	*	0.1	*	0.2	1.0	*	0.1	0.1	0.2	0.1	0.5	0.4	0.1	0.2	0.3	0.1	0.8
Coating, Forming, Agglomerating		16.3	4.8	*	0.1	0.1	*	4.7	*	*	*	*	0.1	2.0	*	1.9	0.6	1.1	0.1	0.7
Construction Materials**		422.7	75.2	1.2	6.2	1.9	5.3	67.2	1.0	14.8	29.5	8.3	7.6	71.7	54.5	3.8	7.0	11.4	2.9	53.2
Ferrous metals & alloys		125.9	21.5	0.3	1.2	0.6	2.8	11.7	0.3	5.9	8.0	2.0	1.7	41.8	13.3	1.5	1.4	3.8	1.3	6.3
Non-ferrous metals & alloys		105.4	15.5	*	0.2	0.6	0.6	8.2	0.1	0.2	8.8	0.5	1.5	4.6	28.1	0.4	2.6	2.0	0.2	31.3
Metal-fabricated parts		47.1	6.1	0.4	0.4	0.2	0.6	7.6	0.1	3.8	2.2	3.2	0.8	12.2	4.1	0.3	1.0	1.6	0.2	2.4
Rubber and plastics		30.2	2.3	*	0.8	0.1	0.2	8.2	0.2	0.1	2.3	0.3	0.6	6.0	0.3	0.5	0.7	2.7	0.1	4.9
Glass, ceramic and graphite		85.1	29.9	0.4	3.6	0.4	1.1	31.5	0.3	4.8	8.1	2.3	2.9	7.0	8.8	1.1	0.9	1.2	1.1	8.4
Paint and protective coatings		18.8	5.7	0.2	0.5	0.2	0.6	7.6	0.1	0.5	0.7	0.7	1.3	2.1	4.2	0.4	0.3	0.6	0.5	2.6
Plant Construction & Aux.		215.8	51.9	0.4	7.6	0.9	3.8	39.6	3.4	23.9	11.0	4.0	3.6	13.7	18.5	2.0	10.9	6.5	4.1	10.1
Plant construction		165.1	41.3	0.3	6.7	0.9	3.6	38.7	3.4	23.9	6.5	3.7	3.4	12.3	16.1	2.0	9.3	6.3	4.0	8.5
Fire protection		22.8	8.4	0.1	0.2	0.1	0.2	3.3	0.3	0.2	0.2	0.6	0.4	1.0	2.3	0.1	4.1	0.5	0.1	0.7
Safety		10.1	4.1	*	0.2	0.1	0.2	1.0	0.1	0.3	0.4	0.3	0.4	0.6	1.0	0.1	0.5	0.4	0.1	0.5
Water supply, sewage disposal		17.7	3.6	*	0.8	*	0.1	0.8	*	0.1	4.5	0.2	0.2	1.4	2.4	*	1.6	0.2	0.2	1.6

\* Less than 0.1 (\$100,000). \*\* For equipment (except piping and tubing).



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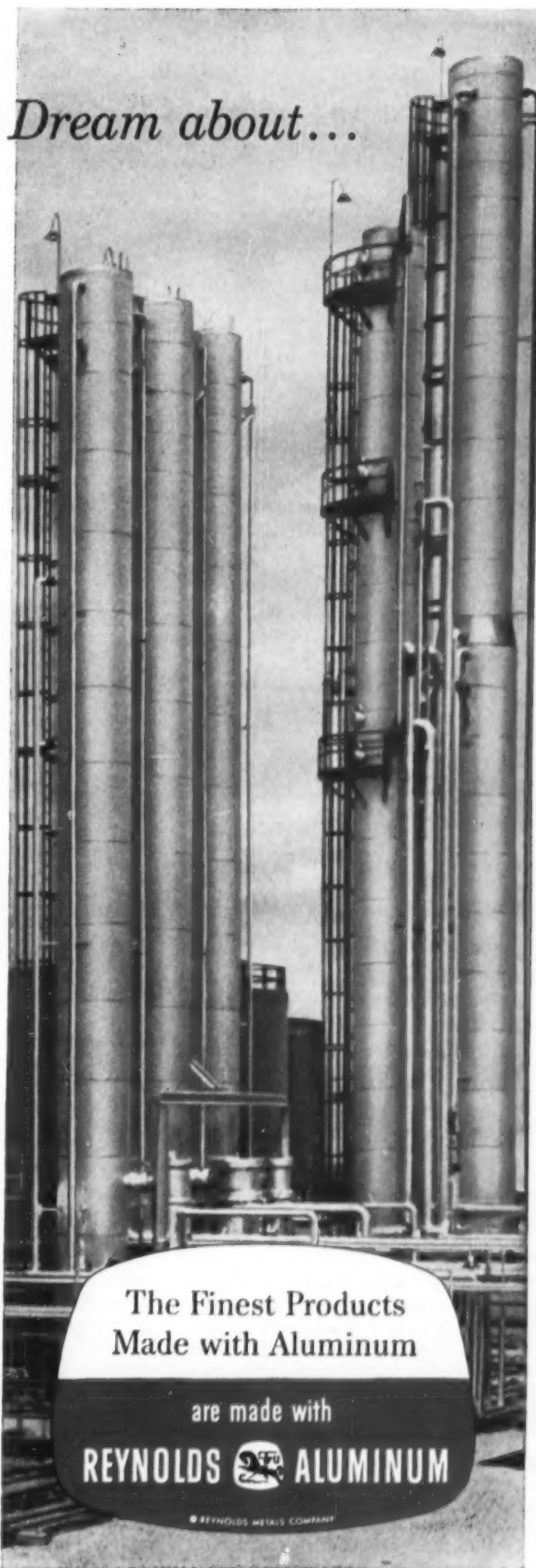
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## Pesticide Production Insecticides Had a Big Year

(Thousand pounds)

	1955	1956			Crop Year (Oct.-Sept.)	
	4th Quarter	1st	2nd	3rd*	1955-56*	1954-55
BHC (gamma; except lindane)	2,377	3,219	4,142	6,000	15,738	8,852
DDT	31,575	33,418	36,789	33,000	134,771	110,550
DDT exports	9,502	22,583	18,151			50,968
2, 4-D acid	8,490	7,784	7,750*	6,000	30,024	33,100*
2, 4, 5-T acid	840	1,187	1,320	1,000	4,347	2,475*
Calcium arsenate	1,200*	4,500*	7,342	12,000	25,000	3,700*
Lead arsenate	4,758*	5,252	3,008	1,500	14,518	12,500*
Sodium chlorate	25,266	24,608	28,524	26,000	104,000	89,540
Pyrethrum imports (flower equiv.)	1,614	2,808	1,252			7,671
Rotenone imports (root)	1,428	1,373	1,706			5,954

Source: U. S. Dept. of Agriculture. \*Estimated.

## '56 Pesticides: Ups and Downs

Was this crop year a good one for pesticides? It depends on where you sit. Basic producers did fine but distributors found the profit road a lot rougher.

Melvin Goldberg, Pesticide Advisory Service, New York, N. Y.

An appraisal, from the profit point of view, of pesticide performance during the 1955-56 crop season depends on whose viewpoint you're taking—the manufacturers of the basic materials or the formulators and distributors of semi-processed and finished pesticides.

Basic producers had an exceptionally good year. Between 15-20% more technical pesticide materials was produced and sold with good profit in this last crop year (Oct. 1, 1955-Sept. 30, 1956) than during the previous crop year.

Formulators and distributors had only a fair year. Insecticide consumption, traditionally tied to the whims of weather and cotton production didn't measure up to expectations.\* Supply outpaced demand and insecticide inventories, heavy

and high-priced, had to be disposed of at unfavorable prices or carried over.

Now although things went well for pesticide producers this year, they have one sobering thought: A good deal of the accelerated production went into filling empty pipelines. Inventories of technical materials and formulations in the field were at a very low ebb at the start of the 1955-56 crop season, needed replenishing even for a year of only average consumption.

So with only average consumption in 1955-56, inventories of finished formulations will be fairly high to start off the 1956-57 crop year. Thus the plight of the dealers this year, swollen inventories, may be the concern as well of the producers next year who may be forced to cut

back their output. And a lot of pesticides in dealers' warehouses are on consignment order, still belong to the producers who may not ultimately get the price they expected.

► **Still the Crying Need**—Best hope for economic stability throughout the pesticide industry next year or any year continues to be a stepped-up, more aggressive program for educating the ultimate consumer, the farmer. A program to persuade him to regard pesticide application as a regular preventive measure rather than a curative step after the pests hit.\*

Enough of a profit margin must be in the price of technical materials, semi-processed materials and finished pesticides to cushion against curtailed use in any season because of lower infestation, unfavorable weather and other factors. The general agriculture picture is always going to be tied to national administration policy. Of this industry spokesmen are well aware. But the industry's future would be healthier if seasonal variations in volume and demand did not prompt them to push material out at a loss.

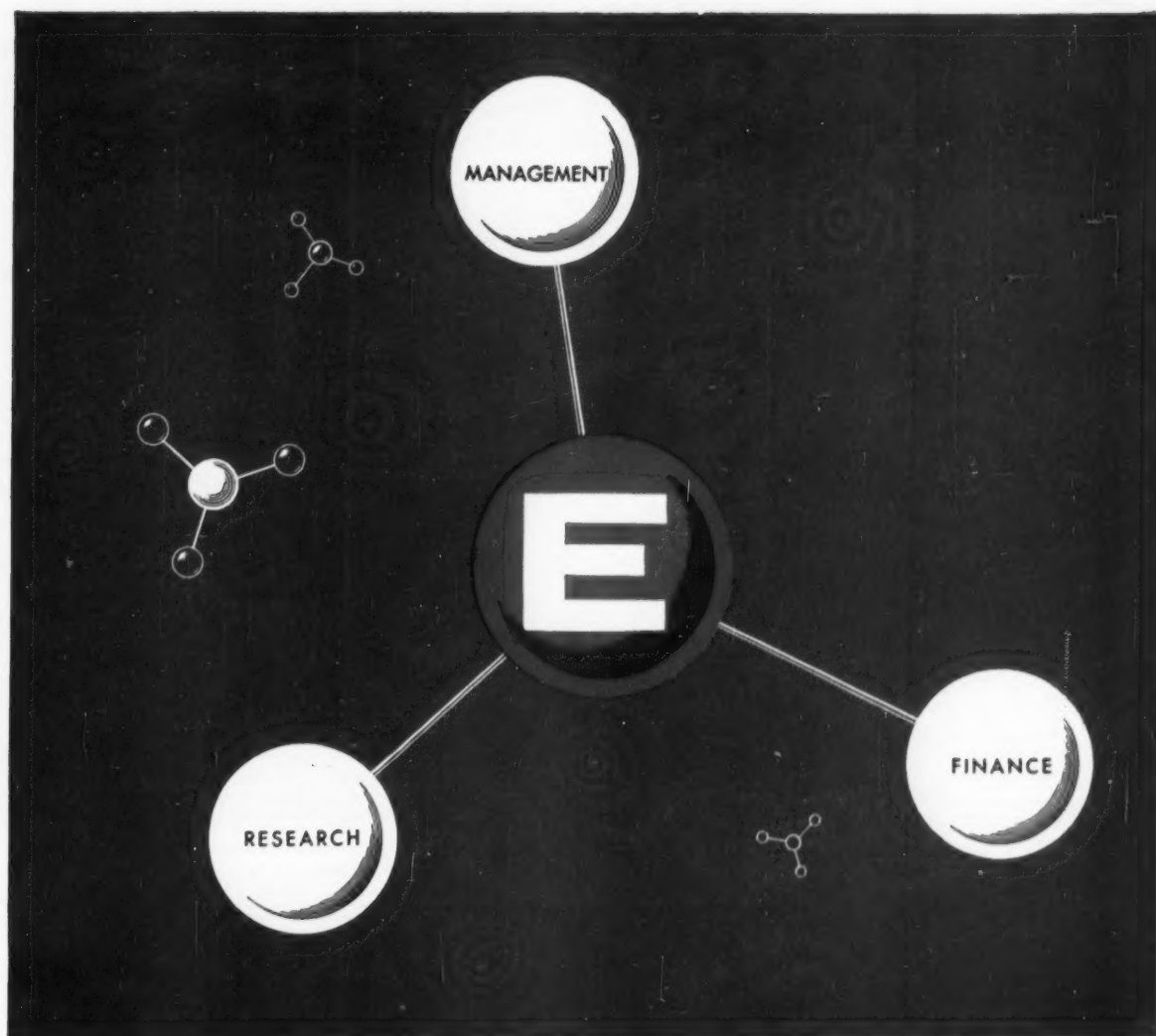
► **Around the U. S.**—Let's see what the pesticide picture is around the country.

• **West:** a fine year, profit-wise and volume-wise, with the outlook for 1957 just as good. Although the year started out rather slowly for pesticides, weather improvement in spring and summer made crop spraying necessary. Soil pest chemicals and miticides were best sellers.

• **South:** only a fair year but showing signs that education is beginning to pay dividends. 1955-56 started out very strongly but June's hot weather dampened early optimism for large volume use of insecticides. Resistance by certain insects to chlorinated hydrocarbons and price slashing disturbed the selling picture during the season. The hope

\* This is why herbicide development promises more stability for the pesticide industry. It's easier to show a farmer that his land needs fertilizers and herbicides on a fairly regular basis than it is to show him that he should guard against insects that may never appear.





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for firmer prices from expected shortages of basic raw materials and formulations died with the decline of infestation. Yet industry observers were quick to point out that despite the less-than-expected infestation, a pretty fair share of pesticides was used—a tribute to industry's educational program urging insecticides for preventive application.

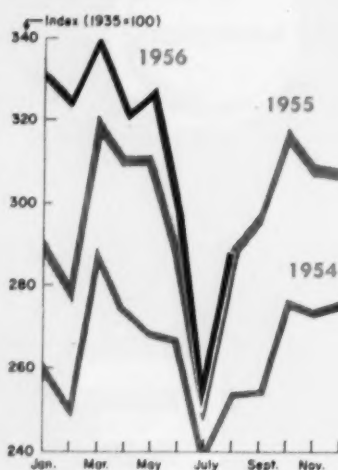
• **Midwest:** pretty good, but weather again was a depressant. There were no extensive insect outbreaks in the Midwest this year although unlooked-for heavy rains in early summer brought on a host of weeds, prompted excellent herbicide sales. Grasshopper control was an important volume mover of insecticides; increasing use of granular DDT, granular Dieldrin and other chlorinated insecticides for this purpose will certainly improve volume in coming years. Insect resistance, already apparent and effectively combated in previous years, was not much of a problem in 1955-56. But price cutting and distribution troubles were characteristic of the Midwest this year.

• **East and Northeast:** only moderately retarded despite unfavorable weather. Consumption in the east is a bit more even than in other areas of the country because there is a greater variety of crops grown. Furthermore, eastern distributors and dealers carried on a rather successful educational program for pesticide use.

► **Outside Complications**—Pesticide industry problems usually stem from within, problems like lack of consumer education, price competition, insect resistance. Lately, though, these problems have been complicated by developments from without: the trends in the agricultural economy and the Miller Bill.

The Miller Bill, which in effect requires additional research and developmental work before a new pesticide can be safely introduced, will undoubtedly cut down the number of new products available to the pesticides industry. In addition, it will take a great deal more education and documentation to get farmers and food

### Chemical Consumption



### Consumption by Industries

	July (Final)	Aug. (Est.)
Coal products .....	3.5	9.9
Explosives .....	10.1	11.8
Fertilizer .....	45.6	47.8
Glass .....	26.7	29.1
Iron & steel .....	3.0	14.9
Leather .....	4.1	4.0
Paint & varnish .....	32.2	35.3
Petroleum refining .....	32.3	32.2
Plastics .....	19.5	21.5
Pulp & paper .....	34.5	38.6
Rayon .....	24.7	24.9
Rubber .....	5.3	6.6
Textiles .....	8.5	10.3
Total .....	250	287

processors to permit use of these newer materials.

Effects of the soil bank and the general uncertainty in the agriculture economic picture are not easily resolved at this moment. Certainly cutting back of acreage for crop production will affect herbicide use particularly (because herbicides, unlike insecticides, would more probably have been used on soil bank-reserved land).

Actually, the soil bank program could be a two-edged sword for pesticides. It's possible that with reduced acreage, more effort will be made to assure bringing in a maximum crop. On the other hand, it may well be that a farmer will not want to spend additional money

for pesticides even though they may substantially increase his yield.

► **Problems From Within**—Deepening price competition in the field is having its effect on marginal formulators and marginal producers of basic materials. Consignment sales are an old headache to the trade, particularly at the formulator level; there was many a sick national distributor this past season getting his fill of this type of operation.

There are increasing signs of insect resistance to pesticides, particularly to chlorinated hydrocarbons. Mosquitoes, flies, moths, roaches, beetles, worms and, more recently, cotton insects are proving more stubborn.

Temporarily, this problem can be circumvented by greater use of the insecticides which are meeting resistance. Or by using insecticides discarded in previous seasons. Accumulated evidence shows that insects, if not exposed to a particular insecticide over the course of several generations, lose their tolerance to the chemical. Thus a compound which fell out of favor a few years ago may be just the thing that will work right now.

► **Bright Spots, Too**—The overall pesticides picture has its bright hopes, though, apart from the benefits from education.

First are the systemic pesticides which are finding general farmer acceptance. There are many new items in the laboratory and semi-pilot plants which should be available in increasing amounts during the coming seasons.

Another new series of compounds are the specific and selective herbicides. In addition to old standbys like 2,4-D and 2,4,5-T, there are a number of specialized herbicides and defoliants finding increased outlets in agriculture.

► **Big Projects Help**—There are a great number of large projects, financed on the county, state and even national level, taking increased amounts of insecticides. A great deal of publicity was given to the spraying of one million acres of Montana





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forests with DDT to control the spruce budworm. Almost three million acres of land in the mid-west and near Far West were sprayed with Aldrin and Heptachlor for grasshopper control. This should be an ever increasing outlet for insecticides.

Notably impressive was the job done in Florida in which

more than a million and half acres were sprayed with Malathion wettable powder to combat a Mediterranean fruit fly invasion. Some of the acreage was treated with granular Dieldrin. No doubt this extensive program will continue in the coming year.

The new colossal road building program will take hundreds

of tons of herbicides and defoliants. Although this appears to be pretty much of a one-shot proposition (the big need is for clearing the way for the building) the right kind of consumer education could assure a steady maintenance market for many tons of pesticidal chemicals after the highways are in place.

## GUIDED TOUR CONTINUED

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Inside Back Cover



**"Wrinkle-proof suit coming up!"**



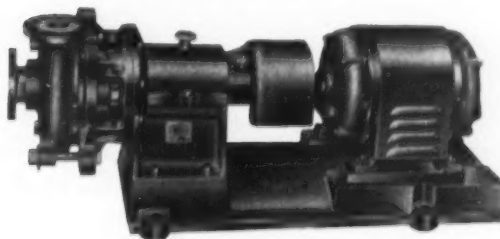
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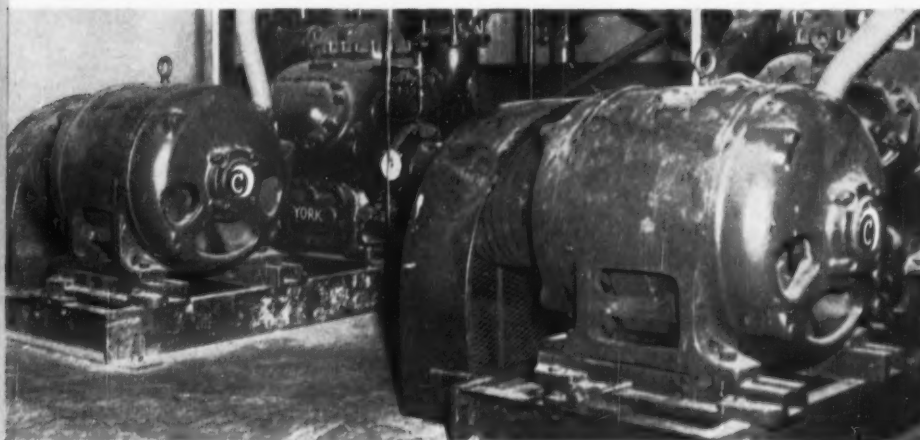
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1/20 to 400 H.P.



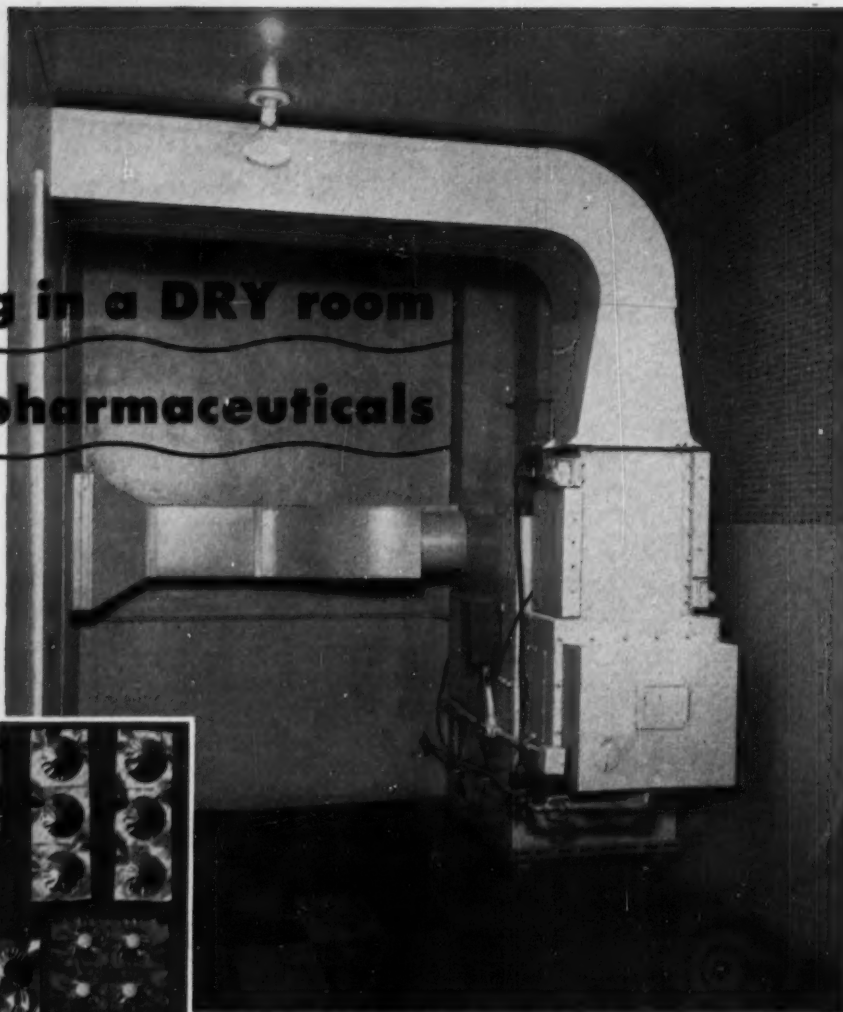
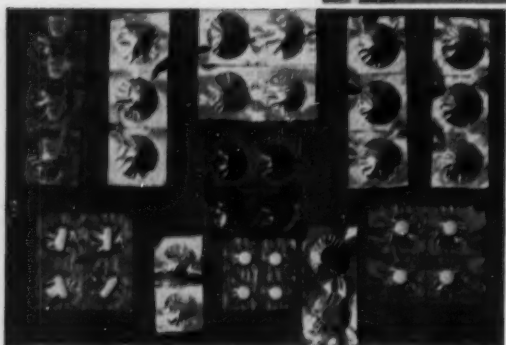
## CENTURY ELECTRIC COMPANY

68

1806 Pine Street • St. Louis 3, Missouri • Offices and Stock Points in Principal Cities



## Packaging in a DRY room protects pharmaceuticals



*Seldom is a Lector dryer\* placed in such colorful surroundings. Mounted on casters, it can be rolled out for easy cleaning.*

● Contract packaging provided by General Packaging Service, Inc. often requires that pharmaceutical products be kept DRY until they're safely sealed in their wrappings. At this new plant in Paramus, New Jersey these moisture-sensitive products are packaged in a DRY room, held below 20% relative humidity.

It's no coincidence that the manufacturers of these pharmaceuticals insist on this protective DRYness. Most of these companies employ

Lectrodryers to DRY the areas in which materials are processed and stored. In many cases, Lectrodryers DRY the air, gases and organic liquids entering into their processes.

Whatever your problem with unwanted moisture, Lector dryer engineers can help solve it. For their advice, or for the book *Because Moisture Isn't Pink*, write Pittsburgh Lector dryer Company, 303 32nd St., Pittsburgh 30, Pa., (a McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.

In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.

In Belgium: S. A. Beige Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

**LECTRODRYERS DRY  
WITH ACTIVATED ALUMINAS**

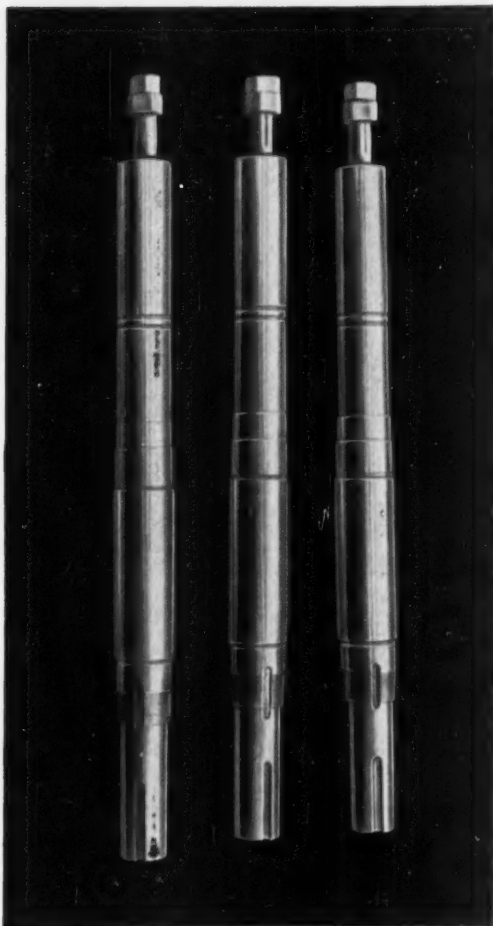
# LECTRODRYER

\* REGISTERED TRADEMARK U.S. PAT. OFF.

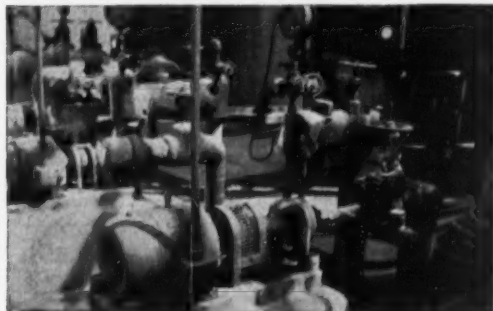


# Refinery Reports Pump Shafts Made of Armco 17-4 PH

## LAST LONGER... COST LESS



Armco 17-4 PH Stainless shafts used in pumps handling aluminum chloride slurry, weak sulfuric acid and similar corrosive materials.



Service records of an Eastern petroleum refinery show that these centrifugal pump shafts made of Armco 17-4 PH® not only cost less to produce but provide much longer service than the material formerly used.

The reason is this new Armco precipitation-hardening stainless steel offers an unusual combination of high strength and hardness, excellent corrosion resistance and simple, low temperature heat treatment in fabrication. It assures trouble-free, long-time service life for valve stems and plugs, shafting, mixing screws and blades, pump gears and other vital parts of chemical processing equipment.

### High Strength Plus Corrosion Resistance

With Armco 17-4 PH you get the advantages of extra high strength and hardness. Mechanical properties like these show why 17-4 PH parts can be made stronger, more resistant to galling and wear.

Typical Properties 17-4 PH Bar  
(Hardened at 875 F for 1 hour)

Ultimate tensile strength, psi.....	180-210,000
0.2% Yield strength, psi.....	165-200,000
Elongation in 2", %.....	8-17
Hardness, Rockwell .....	C40-45

Service data and laboratory tests show that 17-4 PH resists corrosion better than any of the martensitic chromium types of stainless steels. In fact, under certain conditions its corrosion-resistance compares with Type 302.

### Fabrication Easy, Economical

Armco 17-4 PH presents no problems in the shop. It can be readily welded and machined, forged or cast. And the short-time heat treatment at only 850-900 F eliminates the danger of scaling and distortion. Parts can be finish-machined, then hardened without affecting tolerances. If you make or buy equipment that can benefit from the advantages offered by Armco 17-4 PH Stainless Steel bar, wire or forging billets, fill out and mail the coupon for complete information.

#### ARMCO STEEL CORPORATION

1916 Curtis Street, Middletown, Ohio

Please send me information on Armco 17-4 PH Stainless Steel for:

Name.....

Company.....

Street.....

City..... Zone..... State.....

## ARMCO STEEL CORPORATION

1916 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

CHEMICAL ENGINEERING—December 1956





# Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.—America's largest producer of salt



## You Can Save Money on Water Softening—With a "Lixator"

Today, a great many companies using zeolite water softeners are faced with this problem: While the water softener (which needs periodic regeneration with brine) gives excellent performance—regeneration is often costly, time-consuming, and causes substantial waste of salt. This is generally the case when salt is dissolved to form brine without the proper controls.

In most plants, however, it is possible to reduce this high cost of water-softener regeneration. The method is simple and effective: Always regenerate with pure, fully saturated brine—the type of brine made in a Sterling Lixator. Here are some of the reasons why Lixate Brine can save money for users of zeolite water softeners...

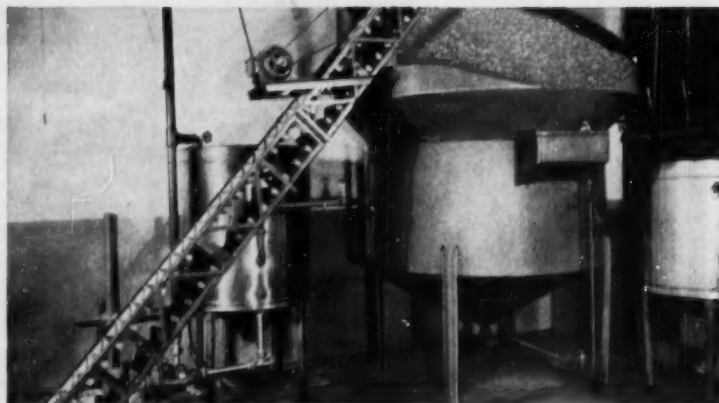
**The Sterling Model Lixator** is the most efficient and economical rock-salt dissolver ever developed. Wherever this fully automatic unit is used in water softening, it reduces the amount of salt consumed... eliminates dry-salt spillage... and simplifies the entire brine-making process. Developed and patented by the International Salt Co., the Lixator combines rock-salt dissolving and brine filtration in one simple operation. It delivers fully saturated crystal-clear brine automatically to any point within a plant. The Lixator is also remarkably easy to maintain, and has no moving parts to get out of order.

**In operation**, a Lixator need not replace the salt-dissolving tanks furnished by water-softener manufacturers. Instead, Lixate Brine is piped to these tanks—which then serve as the storage and measuring tanks from which brine is withdrawn for use.



**Salt handling reduced.** Because Lixate Brine is piped to points of use, the work of hauling dry salt from storage piles to the location of the water softeners is eliminated. Also, because of this direct-piping feature, the Lixator (and the salt that feeds it) can be placed anywhere in the plant, to make the most efficient use of available space. With a self-feeding hopper for salt, the Lixator operates automatically, without attention, and with little or no salt handling.

Lixators are made in a variety of types



At the Libby, McNeill & Libby plant in Hartford, Wisconsin, this Sterling Model Lixator is used for efficient, low-cost water-softener regeneration. A mechanical conveyor fills the Lixator hopper from a nearby rock-salt storage pile. In your plant, a Lixator can also produce substantial savings on salt—and in salt handling as well.

and sizes—to meet the brine needs of individual plants. The principle by which they operate can benefit the largest factory, or even a plant of moderate size.

**Complete regeneration.** Since Lixate Brine is always 100% saturated, it provides complete water-softener regeneration each time. This means that extra regenerations—with the consequent use of more salt—are eliminated. Still another advantage results from using Lixate Brine: Water-softener operators will not use any more of this brine than is needed for each regeneration. What often happens in the case of unsaturated brine is that excess amounts are used in an attempt at complete regeneration. In the long run, this always results in a costly waste of salt.

**Keeps water softeners clean.** Besides being fully saturated, Lixator Brine—produced in a Lixator from economical grades of Sterling Rock Salt—is also self-filtered, and free from insolubles or other foreign matter. As a result, it will not introduce dirt or other "clogging material" into the zeolite bed of the water softener. This has proved to be a particular advantage in industrial water softening—because the zeolite stays in good condition longer. Lixate Brine is also free from acids or alkalies. Thus, being neutral, it cannot adversely affect the performance of any zeolite water-softening system.



### TECHNICAL SERVICE WITH YOUR SALT

Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all types and sizes. And we also make automatic dissolvers in metal or plastic for both kinds of salt. So we can recommend the type and size of salt most perfectly suited to your needs.

If you'd like the assistance of an International "Salt Specialist" on any problem concerning salt or brine—or further information on water-softener regeneration—just contact your nearest International sales office.

**International Salt Co., Scranton, Pa.**

**Sales Offices:** Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; and Richmond, Va.

FOR INDUSTRY, FARM, AND THE HOME—

## STERLING SALT

PRODUCT OF INTERNATIONAL SALT CO., INC.



**THE INDEX**

**TO THIS VOLUME HAS BEEN REMOVED  
FROM THIS POSITION AND PLACED AT  
THE BEGINNING OF THE FILM FOR  
THE CONVENIENCE OF READERS.**



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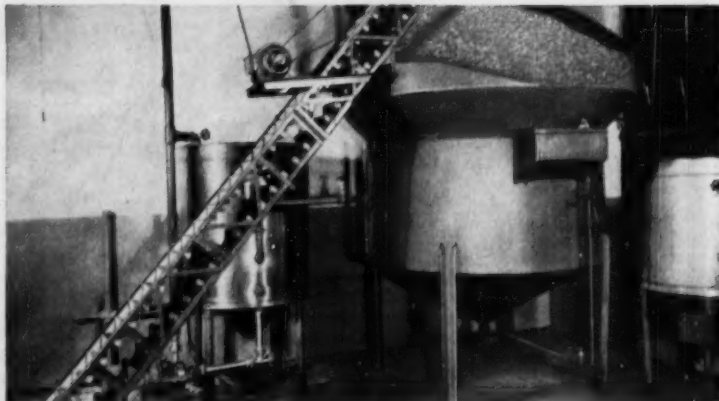
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FOR INDUSTRY, FARM, AND THE HOME—

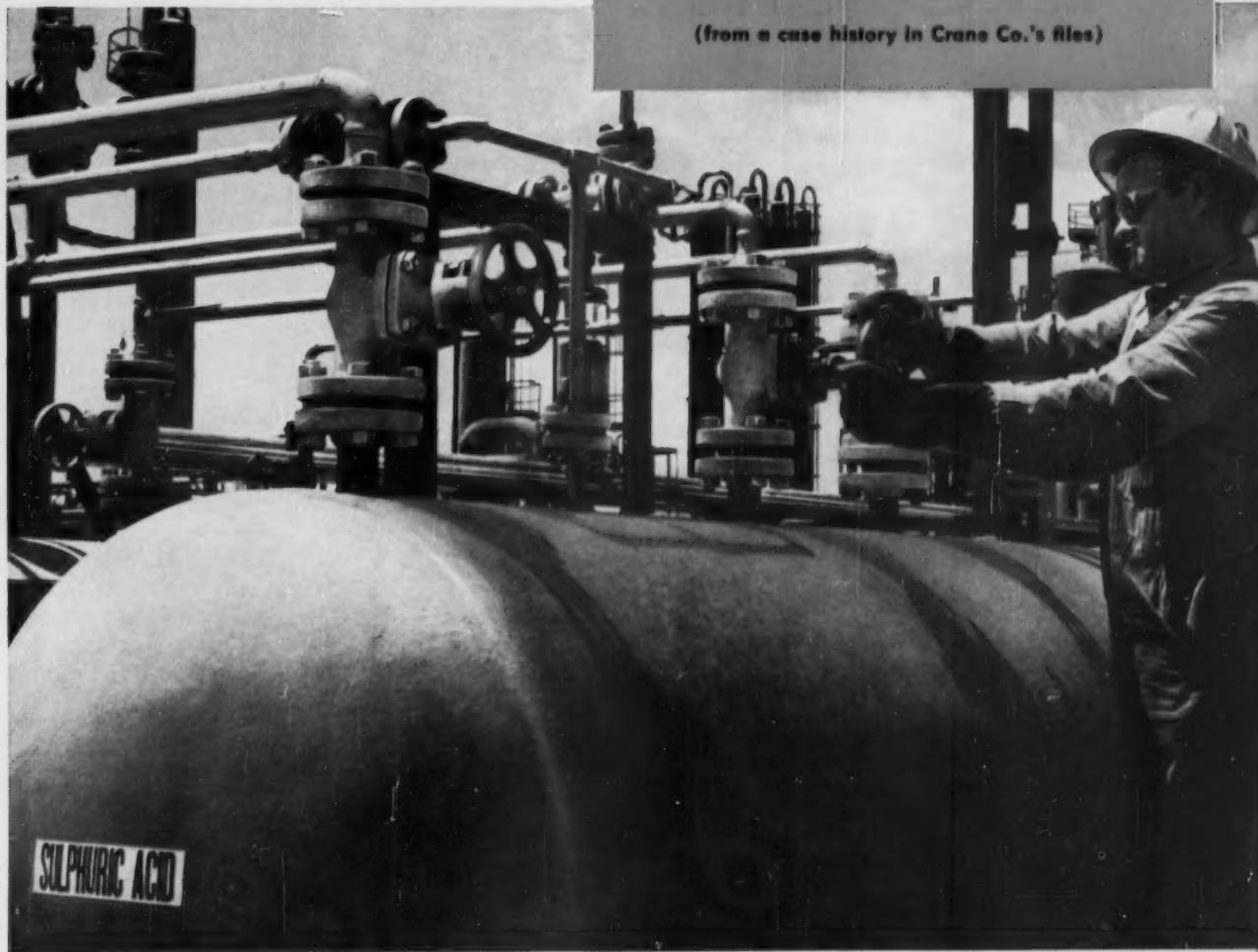
## STERLING SALT

PRODUCT OF INTERNATIONAL SALT CO., INC.



## INTERESTING FACTS ON VALVE PERFORMANCE

(from a case history in Crane Co.'s files)



### 3 years on 93% sulphuric acid at Celanese —no leakage from these Crane valves

This operator is closing valves with cost records clean as a hound's tooth.

They're Crane 1½-inch No. 3615XW steel gate valves, handling 93% sulphuric acid. Celanese Corporation of America installed them 3 years ago in its large petrochemical plant in Bishop, Texas.

After 3 years on service that's rated severe in any plant's books, these Crane valves are *still* tight, *still* operating easily—and they

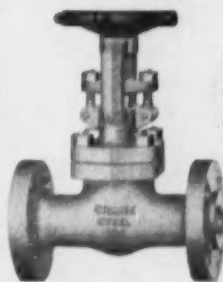
haven't been opened once for repairs or maintenance.

Unusual? Not with Crane valves. They may look similar to other valves on the outside—but inside, they have the design and materials and construction that can mean the difference between good or poor performance.

That's why so many chemical processing plants *specify* Crane valves. That's why you're always

wise to look into the broad Crane line before you buy any valve.

Get the facts from your local Crane Representative, or write to the address below.



**CRANE** VALVES & FITTINGS  
PIPE • KITCHENS • PLUMBING • HEATING

More Facts on  
Small Steel Valves—  
See Over

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas



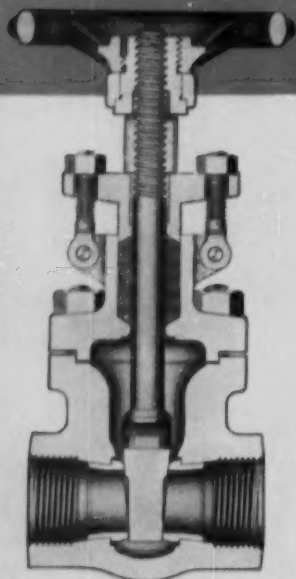
# CRANE 600-pound Small Steel Gate Valves —the type you need—the quality you want

Here, under the trusted Crane label, is a complete line of small steel gate valves with quality features that can't be matched anywhere else—at any price.

Available in the patterns you require, they all have the extra Crane ruggedness... tight seating with durable

seat life... the smooth, rounded contours that assure maximum flow with minimum turbulence... positive operation... and greater freedom from repair and maintenance, which means better flow control at lower cost.

Put any of these Crane 600-pound small steel gate valves on the job—and you have assurance of dependable, lasting service in a wide range of pressure and temperature applications.



Cross section, bolted bonnet pattern, shows quality details and hefty construction.

Check the features of these small steel gate valves and you'll know why they're preferred by critical valve buyers.

They are more compact with weight-saving advantages. Operation is easy, with positive seating of the solid wedge disc assured by the Crane T-head disc-stem connection and the full-length machined guide ribs on disc.

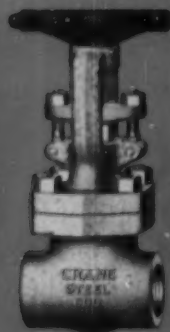
Large, generous stuffing box contains highest grade packing... bonnet joint with gasket is leakproof. To simplify repacking, Crane gives you swinging eye-

bolts and wide yoke with ample working space around the gland.

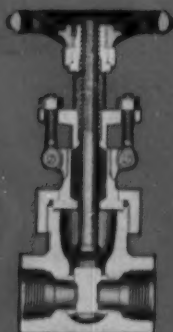
## You name the trim

Choose the trim you need to match your service—Class X Trim (Exelloy disc and body seat rings) for oil or oil vapor... Class XW Trim (Exelloy seat rings and hardened stainless steel disc) for steam or water. Union bonnet valves also available with Class L Trim (18-8 SMO alloy seats, disc, stem) for liquids and gases up to 750° F. Bolted bonnet valves, screwed or flanged end, available with Class A Trim (Monel).

## Bolted Bonnet ½ to 2 in.—Union Bonnet ¼ to 2 in.



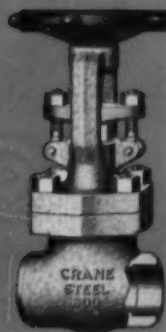
Screwed End Bolted Bonnet



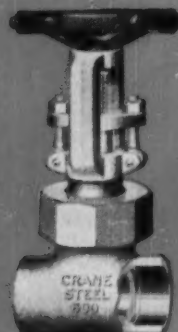
Screwed End Union Bonnet



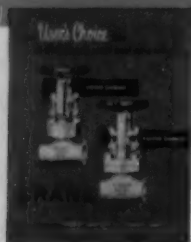
Flanged End Bolted Bonnet



Socket-Welding End Bolted Bonnet



Socket-Welding End Union Bonnet



## Handy "Answer" Folder on Crane Small Steel Gate Valves

At your finger tips, full details on Crane 600-pound small steel gate valves. Ask your Crane Representative for 6-page folder AD-1881. Or write direct. Crane Co., General Offices, Chicago 5, Ill.

Globe, Angle,  
and Check  
Patterns  
also  
available



# DETERGENT ALKYLATE

... pure and simple



*Detergent Alkylate Plant,  
Grange Chemicals Limited,  
Grangemouth, Scotland.*

**P**URE AND SIMPLE ... Key words in the highly competitive detergent field where outstanding product purity and plant operating simplicity mean worthwhile marketing and production advantages.

Both qualities characterize the new plant of Grange Chemicals Limited which was designed and constructed by Stone & Webster Engineering Corporation and its affiliate E. B. Badger & Sons Limited (London) using basic process information developed by the Oronite Chemical Company. Brought on stream smoothly, this plant was producing better than specification product, at design rates, in record breaking time. Contributing to this performance were several process and mechanical features developed especially for this project by Stone & Webster.



**STONE & WEBSTER ENGINEERING CORPORATION**

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York   Boston   Chicago   Pittsburgh   Houston   Los Angeles   San Francisco   Seattle   Toronto



# Now you can buy a Bailey-built HEAT PROVER Analyzer

## CONTINUOUS READINGS OF OXYGEN AND COMBUSTIBLES

The famous Cities Service HEAT PROVER Analyzer, formerly available only on loan, is now manufactured by Bailey Meter Company, and you can buy one outright. With this handy portable instrument, you can easily monitor the per cent of oxygen and combustibles in gases.

The continuous readings from a Bailey HEAT PROVER Analyzer enable furnace, kiln, and engine operators to correct combustion variables before costly losses are incurred. Although it weighs a scant 25 pounds, the HEAT PROVER Analyzer is the key to maximum combustion efficiency. With it, the operator can determine the proper proportion of fuel to air at any time.

The two meters on the analyzer show per cent by volume of oxygen and combustibles on either a 20% range span or a more sensitive 4% range. Temperature of flue gases in degrees Fahrenheit is also shown.

Compared with involved, time-consuming Orsat measurements of flue gases, this new portable analyzer offers these advantages:

1. Simultaneous direct readings of oxygen and combustibles.
2. Negligible time lag between combustion change and reading change.
3. Continuous sampling, analysis, and readings.
4. Convenient measurement of temperature.

Ask your Bailey engineer how you can use this instrument to increase combustion efficiency. Or, write today for more information on how this new Bailey HEAT PROVER Analyzer can pay for itself practically at once.

G-39-1



Flue gas analysis with a Bailey HEAT PROVER Analyzer at a furnace stack. Per cent oxygen and combustibles is shown continuously.

*Instruments and controls for power and process*

## BAILEY METER COMPANY

1054 IVANHOE ROAD

• CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal







THESE **MIDWEST**  
"LONG TANGENT" ELBOWS  
SAVED \$4121 IN PIPE



**MIDWEST "LONG TANGENT"  
ELBOWS COST NO MORE  
THAN OTHER ELBOWS**

Here are 1227 Midwest "Long Tangent" Elbows (12", 14" and 16" standard weight) ready for shipment to a chemical plant. Each Midwest "Long Tangent" Elbow has a straight section on each end equal in length to  $\frac{1}{4}$  the nominal pipe size. Thus a 12" elbow saves 6" of 12" pipe while a 16" elbow saves 8" of 16" pipe. It doesn't take long to save a lot of pipe and a lot of money . . . in this instance \$4121.

But saving pipe is not the only advantage of Midwest "Long Tangent" Elbows. They often eliminate short nipples and their extra welds . . . save time and money in lining up and clamping pipe and fittings . . . slip-on flanges are more easily applied. For all the facts, write for Catalog 54.

### **MIDWEST PIPING COMPANY, INC.**

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Clifton, N. J. and Los Angeles

#### **Sales Offices**

New York 7—50 Church St. • Chicago 3—79 West Monroe St.  
Boston 27—426 First St. • Los Angeles 33—520 Anderson St.  
Houston 2—1213 Capital Ave. • Tulsa 3—224 Wright Bldg.  
Cleveland 14—616 St. Clair Ave. • Miami 34—2103 Le Jeune Rd.

**STOCKING DISTRIBUTORS IN PRINCIPAL CITIES**

# **MIDWEST WELDING FITTINGS**

**MIDWEST WELDING FITTINGS Improve Piping Design and Reduce Costs**







## Genie in the Bottles...POLYURETHANE FOAMS

Celanese serves this fast growing industry with basic chemicals and plasticizers

What is your wish . . . acoustical insulation, clothing interliners or aircraft seat cushions? These and many more are sound applications for the new polyurethane foams. Starting as liquids, these chemical compounds expand up to 20 times their volume, and cure in minutes into rigid or resilient forms as required.

A hundred-and-one industries already are prime markets for the producers of polyurethane foams. And the number is growing daily as manufacturers discover their many advantages—particularly the advantage of flame resistance

which is imparted to the foams by the addition of a plasticizer such as Celanese Celluflex CEF.

In continuous commercial volume Celanese also produces trimethylolpropane . . . a high purity polyol with proven cross-linking properties . . . as well as propylene glycol and 1, 3 butylene glycol. These results of applied research are solving many problems in making the new polyurethane materials ever more useful and economical. Celanese Corporation of America, Chemical Division, Dept. 553-L, 180 Madison Avenue, New York 16, N. Y.

Celanese® Celluflex®

### Basic reasons .....

Acids  
Alcohols  
Aldehydes  
Anhydrides  
Esters

Functional Fluids  
Gasoline Additives  
Glycols  
Ketones  
Oxides

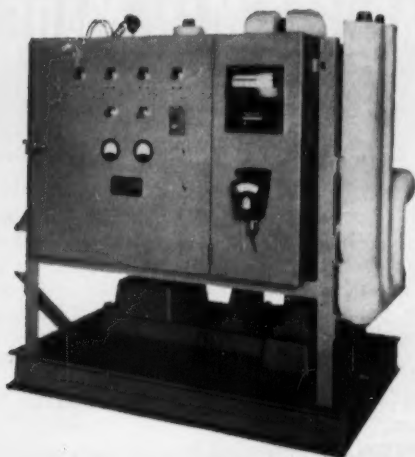
Polyols  
Plasticizers  
Salts  
Solvents  
Vinyl Monomers



### .....for improved products

Agricultural, automotive,  
aviation, building,  
electrical, paper,  
pharmaceutical, plastics,  
surface coatings, textile.



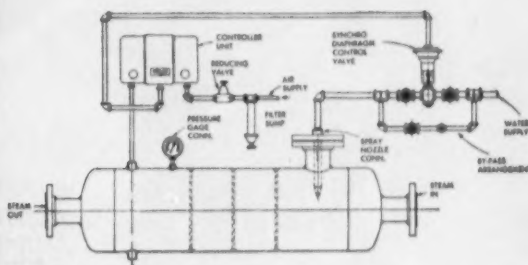


**TRANSFER OIL HEATING SYSTEM** Includes standard heat exchangers and vessels with complete operating controls to maintain oil supply temperature within  $\pm 2^\circ\text{F}$ .



**CHLORINE VAPORIZING SYSTEM** Converts liquid chlorine to dry vapor. Capacities to 8,000 lb./hr. of chlorine with steam at 5 p.s.i.g. All-steel construction, easily disassembled and cleaned.

**DESUPERHEATING SYSTEM** "Washes out" steam superheat through evaporation of a controlled amount of feed water. Four standard size systems handle wide range of steam loads (8,000 to 150,000 lb./hr.)



## COMPLETE "PACKAGE" PROCESS SYSTEMS

Whitlock "Package" Service fulfills every need in procuring your equipment. It covers all engineering, with recommendations based on your actual flow sheets specifying fluids, temperatures, and pressures, which we translate into terms of mechanical equipment. We furnish all component units, including exchangers, tanks, pressure vessels, towers, reactors, condensers, columns, reboilers, coils, piping, and operating controls. We relieve you of the considerable expense and annoyance of purchasing and expediting many supplies from many sources. Our stocks of materials . . . plate, pipe, heads, tubing, forgings and other basic materials for quick fabrication . . . are available in ample supply to permit us to make prompt shipment of your equipment.

This "Package" Service when used to produce units such as the Transfer Oil Heating System, Chlorine Vaporizing System, and Desuperheating System illustrated, can obviously save you time and money. It pays to deal with a single manufacturer — a competent producer of engineered equipment. Write

**The Whitlock Manufacturing Company**  
94 South Street, West Hartford 10, Conn.

*In Canada: Darling Brothers, Limited, Montreal*

# Whitlock

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.





# HARDEST MAN-MADE METAL

TALIDE METAL, a tungsten carbide of superior quality, is harder, stronger, and more resistant to abrasion than any other metal. Properly applied, it gives superior service on applications where wear, heat, strain and shock are destructive to other metals.

- **ABRASION RESISTANCE**—Up to 100 times that of steel.
- **COMPRESSIVE STRENGTH**—Higher than all melted, cast or forged metals and alloys.
- **RESISTANCE TO DEFORMATION**—2 to 3 times greater than steel.
- **HEAT RESISTANCE**—Resists oxidation and thermal shock up to 1500° F.
- **THERMAL EXPANSION**—Less than half the rate of steel, "creep" is negligible.
- **FRICTIONAL RESISTANCE**—Lower than steel, non-galling, "slippery" properties higher.

TALIDE METAL is saving industry millions of dollars annually by wear-proofing vital parts on machine tools, presses, pumps, compressors and other types of processing equipment used in the steel, oil, chemical, plastic, auto, rubber, textile, glass, mining and metal-working industry. The physical properties of the most commonly used grades are listed below. Other grades are available for specialized applications.

## PHYSICAL PROPERTIES OF TALIDE METAL (P. S. I.)

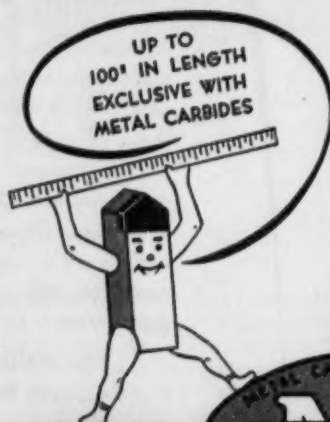
Application	Operation	Talide Grade	Rockwell "C" Hardness	Specific Gravity (heavily)	Transverse Rupture Strength	Compressive Strength	Co-Efficient of Thermal Expansion	Modulus of Elasticity (Deflection)
WEAR SURFACE	No Shock	C-91	91.8	14.90	235,000	710,000	3.00 x 10 <sup>-6</sup>	91,000,000
	Light Shock	C-88	91.0	14.75	265,000	670,000	3.65 x 10 <sup>-6</sup>	84,000,000
	Medium Shock	C-88	89.5	14.55	295,000	635,000	4.00 x 10 <sup>-6</sup>	80,000,000
IMPACT	Light	C-85	88.4	14.25	315,000	600,000	3.75 x 10 <sup>-6</sup>	77,000,000
	Medium	C-80	87.0	13.85	335,000	550,000	4.50 x 10 <sup>-6</sup>	74,000,000
	Heavy	C-75	85.0	13.15	355,000	500,000	5.00 x 10 <sup>-6</sup>	70,000,000

Note: Hardness values may vary plus or minus .2 to .3 on individual lots.

All TALIDE METAL grades are made in latest type vacuum electric furnaces by precision methods under rigid control. A wide variety of shapes and sizes can be supplied—up to 25" in diameter, 100" in length, and 5000 pounds by weight. Parts can be supplied to any grit finish required down to one micro-inch.

Metal Carbides Corporation,  
Youngstown 12, Ohio.

Send for new 76-page catalog  
56-G or ask for sales  
engineer to call.

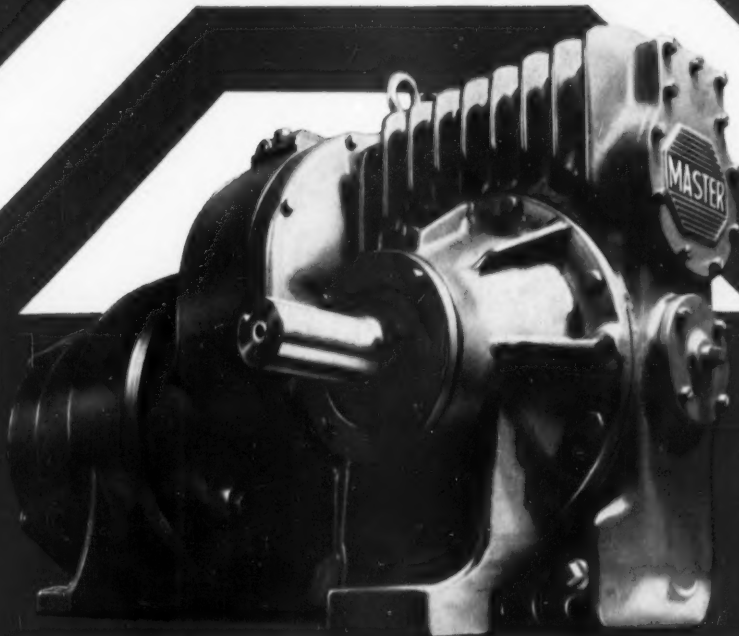




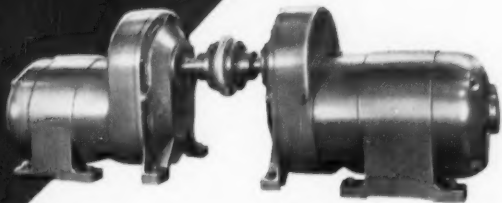


## still the All-American First

Master Gearmotors have given more millions of hours of satisfactory service in the field than all other makes combined.



CONTINUOUS LIFE TESTING  
MAINTAINS  
CUSTOMER SATISFACTION

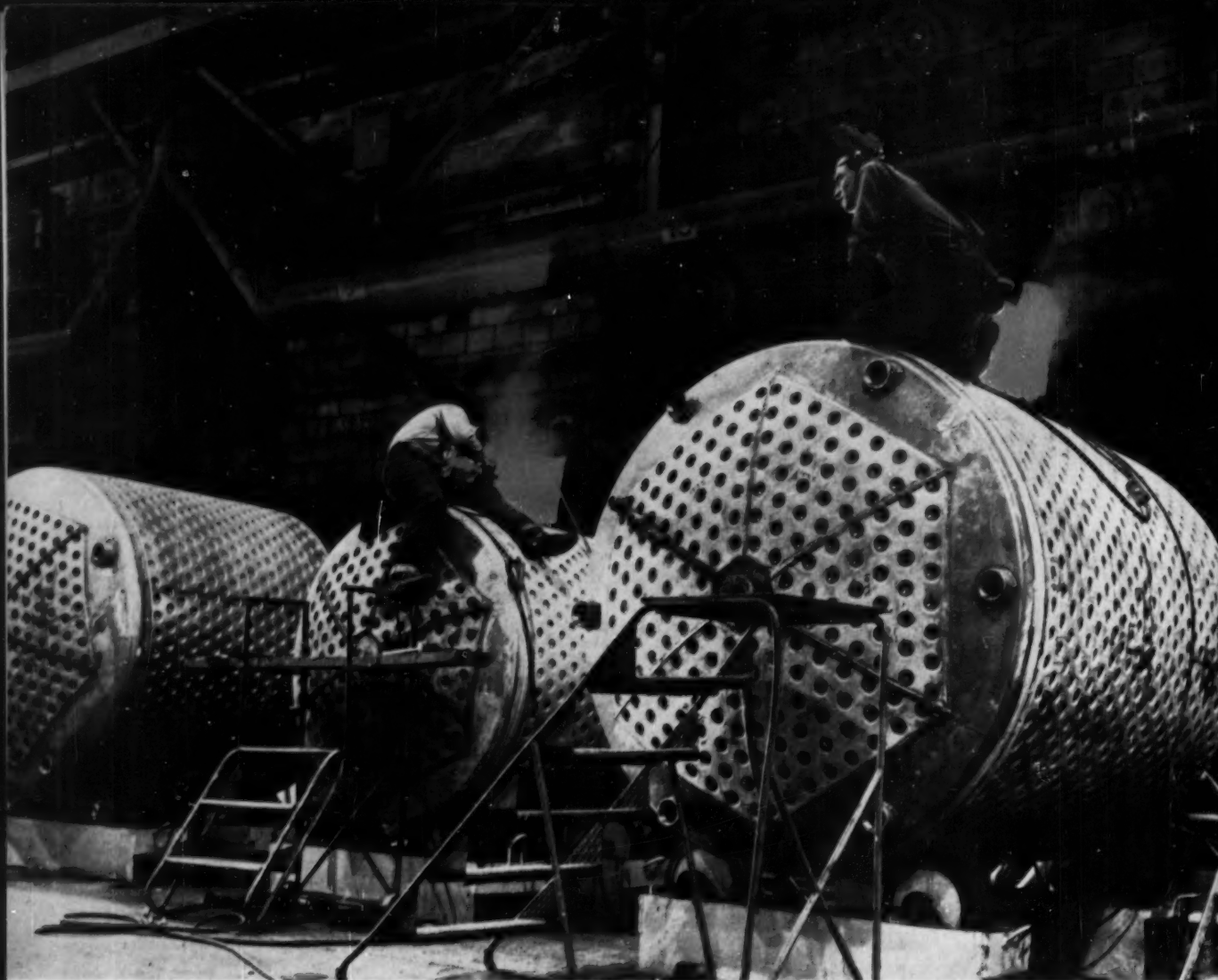


How can we help YOU?

For five years without stopping, these two 326 frame single reduction gearmotors were run continuously 24 hours a day at full load, one as an induction generator, the other as a gearmotor. When shut down and inspected, Master's conservative design showed gear wear of less than .001".

**THE MASTER ELECTRIC COMPANY • Dayton 1, Ohio**





These dimpled jacketed reactors are code-accepted for pressures far beyond conventional jackets of equivalent wall thickness.

## You get more for your stainless steel dollar in these *dimpled* jacketed vessels

Substantial cost savings can be yours when you take advantage of Pfaudler's exclusive code-approved dimpled jacket on stainless steel processing vessels.

This design permits jacket pressures up to 150 psi *without increasing metal thickness!* And it is only one of many ideas Pfaudler has evolved to give you more for your stainless steel dollar.

To start with, you have a choice of *standard designs* from which you can select jacketed reactors or kettles

from 5 to 2000 gallons. They are built of Types 304 and 316 stainless steel which are carried in stock along with such prefabricated parts as nozzle openings, agitators, stuffing boxes and drives.

Generally, units from 5 to 500 gallons have conventional jackets and clamped-top heads. There are ample openings to accommodate most processes.

By taking advantage of all of these features, you not only save money but get your equipment faster. You auto-

matically eliminate the time consumed in preparing engineering drawings and estimating prices. All you need really is our Bulletin No. 904 which spells out sizes and detailed specs.

---

### Heat treating can mean big savings, too

Frequently, you can use a cheaper grade of stainless steel by having it heat treated after fabrication. Pfaudler facilities will handle a vessel of almost any size.

**THE PFAUDLER CO.**  
ROCHESTER 3, N. Y.



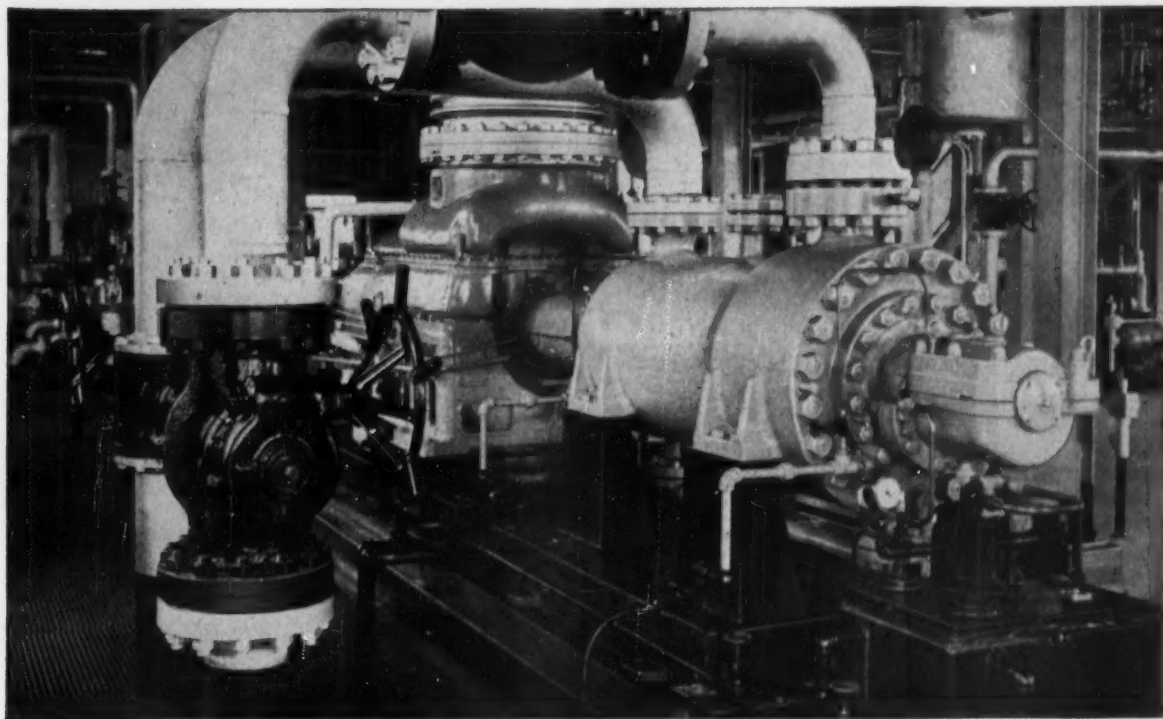
Specialists in Corrosioneering



# Ingersoll-Rand High-Pressure Pumps at the Katy Cycling Plant

## SET IMPRESSIVE RECORD

### of Maintenance-Free Operation



1943  
1944  
1945  
1946  
1947  
1948  
1949  
1950  
1951  
1952  
1953  
1954  
1955  
1956

**13**

**years without opening!**

Two nine-stage CHT pumps were put into service at the Katy Cycling Plant in July 1943. These five-inch, double-case units, one of which is shown above, take lean oil at about 90°F. and 70 psi from the still after coolers and discharge it to the absorbers at 1850 psi. Throughout this entire thirteen year period, the pump casings have not been opened. The original bearing linings are still in service and the only maintenance required has been the renewal of inboard shaft sleeves and infrequent repacking. A third I-R pump of the same design, installed in 1944, has required no repairs to date.

This outstanding performance record is a typical example of the *extra dependability* that's built into every Ingersoll-Rand pump. Each unit is designed for real, long range economy that pays off in lower operating and maintenance costs year after year. If you have a pumping problem, your nearest I-R representative will be glad to help you.

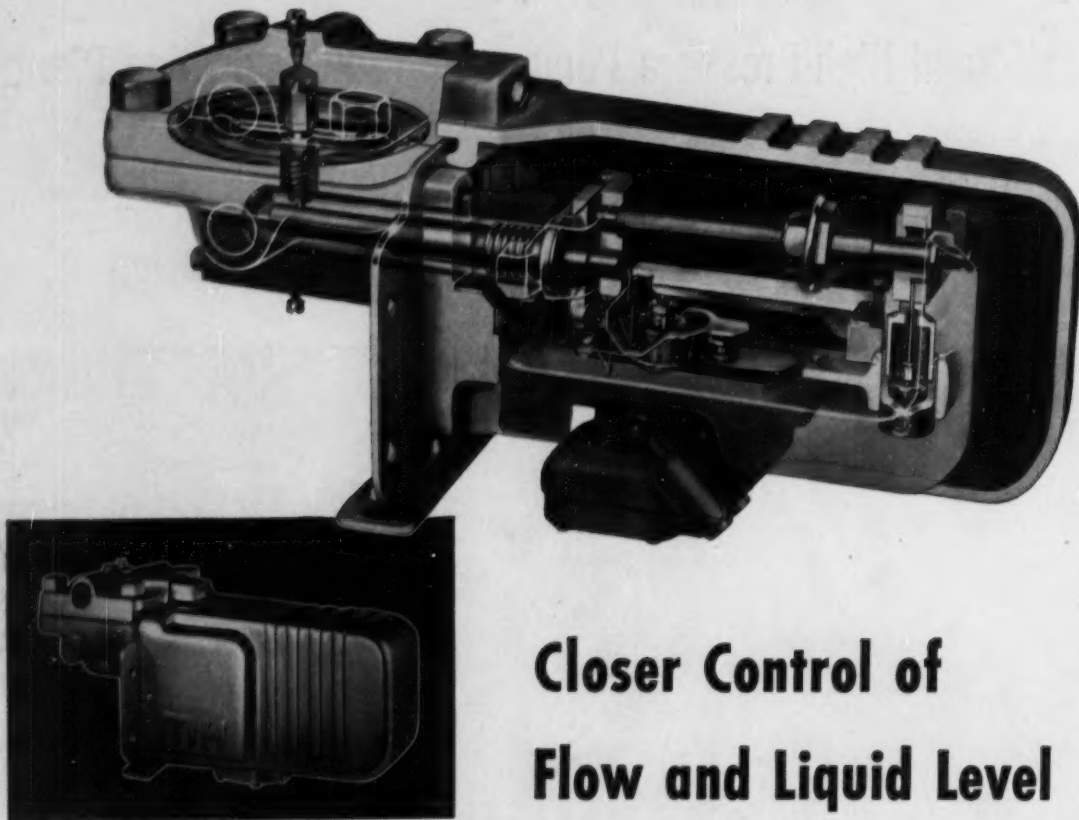


**Ingersoll-Rand**

11 Broadway, New York 4, N. Y.

10-438





## Closer Control of Flow and Liquid Level

... with Honeywell's Differential Converter

USE THIS mercuryless remote transmitter for practically any application requiring precise, high-speed measurement of flow or liquid level. It's accurate within 1%. Equally fast in response up the scale or down. Range is continually adjustable in the field. Mount this compact, lightweight unit anywhere.

The *Differential Converter* operates on the force-balance principle, transmitting by a single air line to a pneumatic receiver as far as 1,000 feet away. It's the ideal companion for Honeywell

*Tel-O-Set* miniature recorders, indicators and controllers.

For details on how *Differential Converters* make possible tighter control in your most critical applications, call your nearby Honeywell sales engineer today. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO.,  
*Industrial Division*, Wayne and Windrim  
Avenues, Philadelphia 44, Pa.—in Canada, Tor-  
onto 17, Ontario.

**For measuring liquid level in closed tanks:** One model with a normal range of 0-14 to 0-200 inches of water, and two suppression ranges of 0-75 and 50-200 inches. Suppression spring permits direct, instead of reverse, reading of instrument.

**For measuring flow and liquid level in open tanks:** Two models with ranges from 0-20 to 0-200 inches of water differential and 0-100 to 0-1000 inches.

● **REFERENCE DATA:** Write for Bulletin 2290-1, "Differential Converter Liquid Level Transmitter"; Catalog 2321 "Flow Meters"; and Specification 248, "Differential Converter Flow Transmitter".



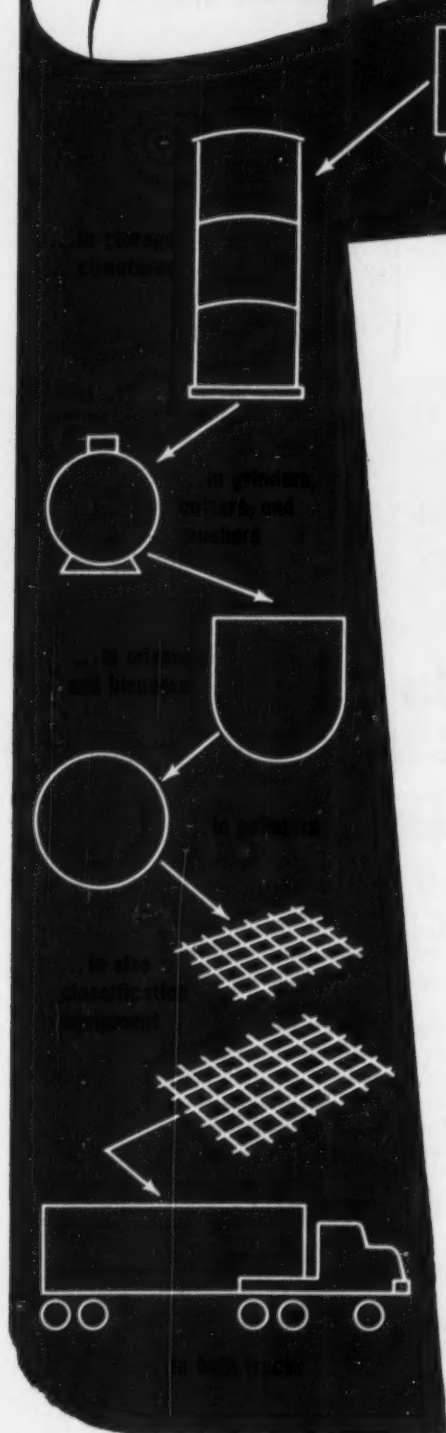
MINNEAPOLIS  
**Honeywell**  
BROWN INSTRUMENTS

*First in Controls*



GET SPROUT-WALDRON'S

# Big Plus



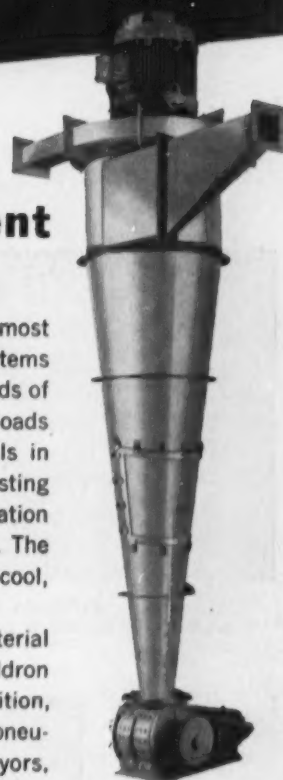
## ...in Materials Handling Equipment

PNEU-VAC, shown here, is one of the most modern negative-pressure pneumatic systems available . . . has proved itself in hundreds of installations. It conveys, loads, and unloads granular, pulverized, and flaky materials in tremendous volumes without exterior dusting . . . without intercontamination or infestation of products . . . without handling losses. The unit is self-cleaning and can be made to cool, to heat, to aerate, to dry.

For small and medium size bulk material handling requirements, the Sprout-Waldron pneumatic **Airo-Flow** is available. In addition, Sprout-Waldron offers complete lines of pneumatic bulk trucks, screw and belt conveyors, bucket elevators, and feeders—all with Sprout-Waldron's **BIG PLUS**.

The **BIG PLUS** gives you—at no extra cost—expert engineering guidance on installations and applications . . . plus wide selections of all types of materials handling equipment . . . plus the unique ability to "adaptioneer" equipment to meet your specific needs . . . plus 100% reliability.

Put Sprout-Waldron's **BIG PLUS** to work for you. Let us analyze your materials handling problems and recommend solutions that will cut your costs and save you money. Write for full details.



**SPROUT-WALDRON**

*Manufacturing Engineers Since 1866*

15 LOGAN STREET • MUNCY, PA.



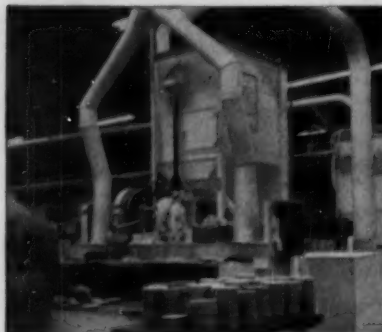
PR/426



# Lenox China obtains dust-free plant with

## WHEELABRATOR<sup>®</sup> DUSTUBE<sup>®</sup> COLLECTORS

Dust is a constant threat to the creation of fine china, and quality has been the watchword at Lenox, Incorporated, since its founding 70 years ago. When a new plant was built at Pomona, N. J., in 1954, Wheelabrator Dustube Collectors were selected to provide the rigid dust control required. Ten units are used throughout the plant to ventilate mixing, molding, trimming, blasting, grinding and polishing operations. W. N. McGraw, Plant Engineer reports, "The Wheelabrator units have been more than satisfactory."

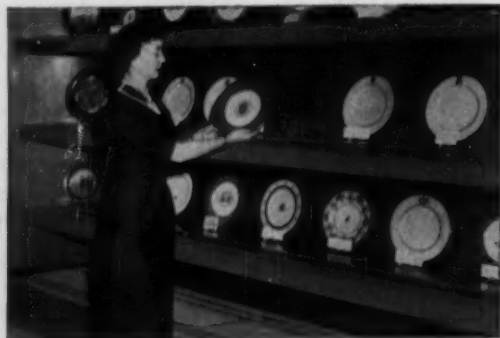


Wheelabrator Collectors ventilate sandblasting operations performed after firing.



Dust resulting from grinding is vented to the Dustube Collector at far left.

TEN COLLECTORS  
TRAP DUST AT ITS  
SOURCE THRUOUT  
MANUFACTURING  
PROCESS



Dinner service, furnished the White House since the first order by President Wilson in 1917, is included in this display of Lenox China.



Wheelabrator Collectors ventilate the mold making department (top photo) and trimming operations (below).

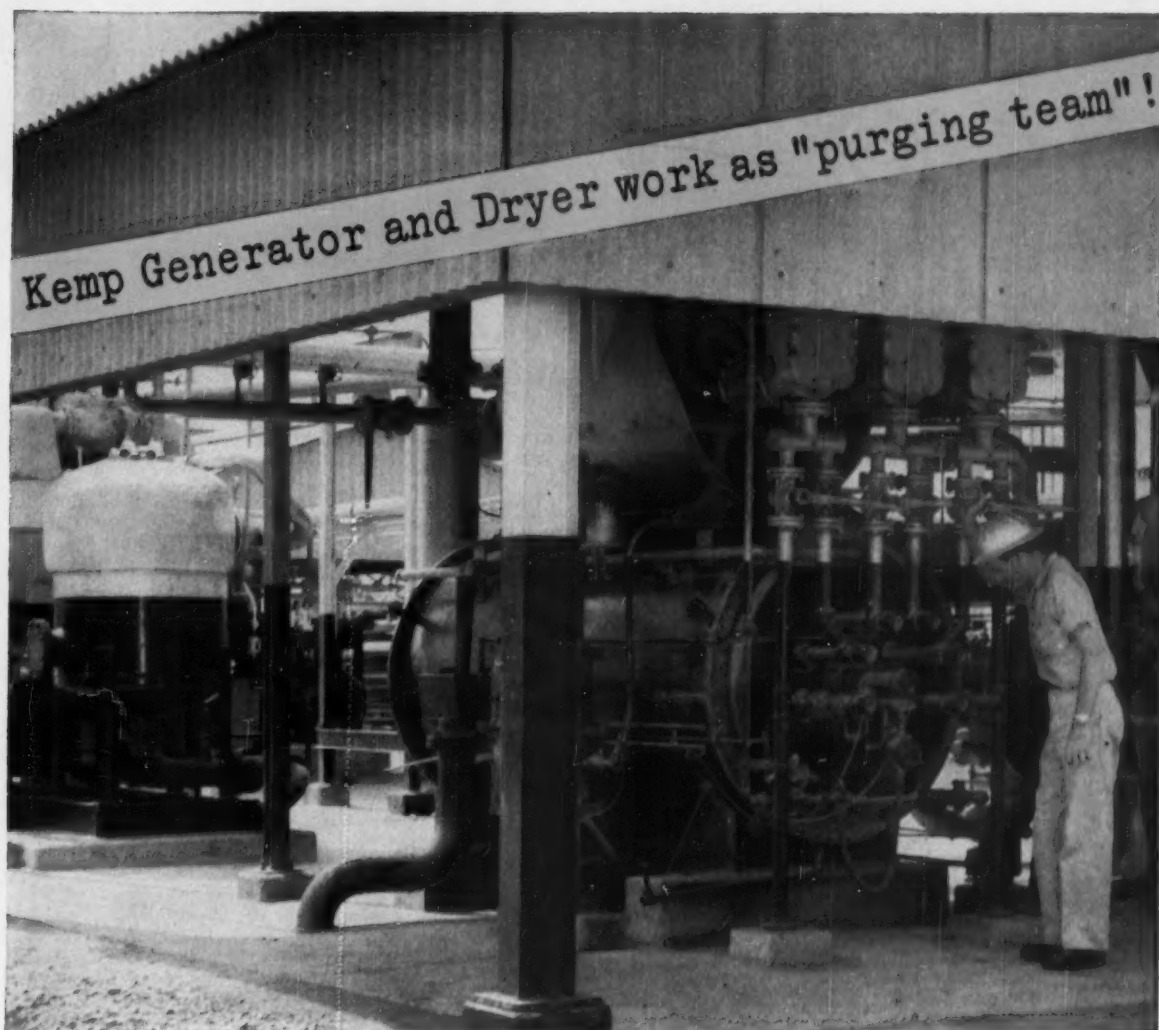
For information on how Wheelabrator Dustube Collectors can make your plant dust-free, too, write today for Catalog 372.



**WHEELABRATOR**  
CORPORATION

347 South Byrkit Street, Mishawaka, Indiana





## **Gulf Oil Reports: Pipe line purging problems solved by Kemp Gas Generator and Kemp Dryer**

At Gulf Oil's Port Arthur, Texas refinery, dry inert gas is required in the Ethylene Plant for purging pipe lines, tanks and vessels.

### **Kemp Units selected to do the job**

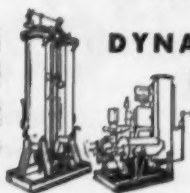
To insure a constant supply of gas—sufficiently dry and free of oil vapors—Gulf installed both a Kemp Inert Gas Generator and a Kemp Convection Type Dryer. The units work as a "purging team"...the Kemp Generator produces 30,000 SCFH of inert gas which is compressed and passed through a Kemp Pre-filter to remove all moisture prior to entering the gas receiver. The result is an efficient, easily controlled source of dry inert gas at all times.

### **Kemp can solve your problem too**

Whether your needs involve dry gases, inert gases—or both, Kemp can help you to the most profitable solution. Kemp Inert Gas Generators automatically deliver clean, controlled atmospheres at specific analysis, without fluctuation—regardless of demands. A variety of Kemp Dryers are designed to dry air, gases or liquids to sub-zero dew points and are available with manual, semi-automatic or fully automatic tower reactivation. In addition, Kemp will specify the proper desiccant for the job.

For complete facts and technical information on Kemp Inert Gas Generators and Kemp Dryers, write today to: The C. M. Kemp Mfg. Co., 405 East Oliver St., Baltimore 2, Maryland.

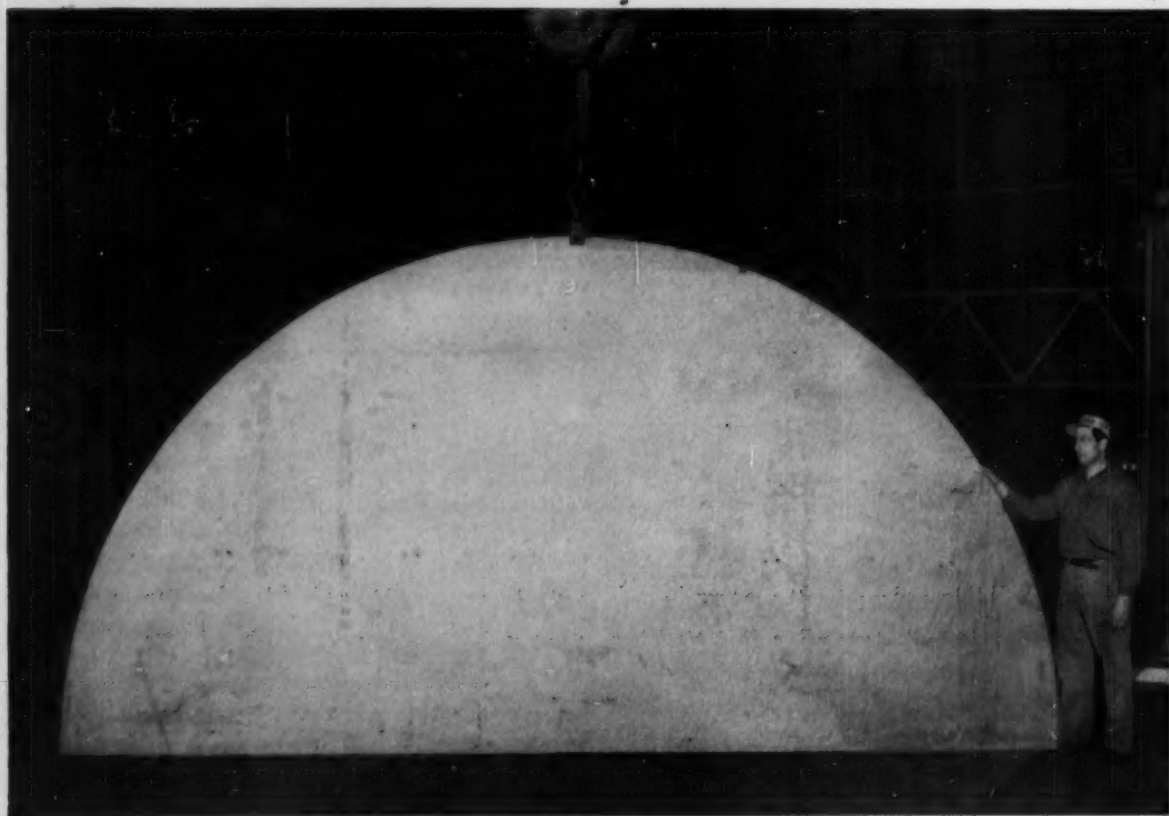
**KEMP**  
OF BALTIMORE



### **DYNAMIC DRYERS INERT GAS GENERATORS**

CARBURETORS • BURNERS • FIRE CHECKS  
METAL MELTING UNITS • SINGING EQUIPMENT





## Carlson specialized service keeps your costs low

**Here's how Carlson specialized service in stainless plate worked on this job.**

The illustration shows one of two segments of a tank head blank. Made of 1" thick, Type 302 stainless steel, the head blank measures 210" in diameter and weighs approximately 9000 pounds. Each segment was produced so accurately the customer did not have to "true up" the abrasive cut straight edges before welding the two segments together. This meant the customer had what he wanted, the way he wanted it—produced to his exact requirements.

**And here's why you'll want this specialized Carlson service.**

More than once we've helped a customer do his job easier, quicker and at lower cost by efficient planning and expert use of specialized equipment. This experience

can work to your advantage, too. You can buy *exactly* what your specifications call for—and nothing more. This saves freight charges on material you cannot use. It also saves the cost and trouble of handling scrap in your shop. And you can set up a faster production schedule based on receiving what you want, when you want it.

Stainless steel is our *only* business—and we know it! Let us show you how this *specialized service* can help you. Your inquiry will receive prompt attention.

**G. Q. CARLSON, INC.**

*Stainless Steels Exclusively*

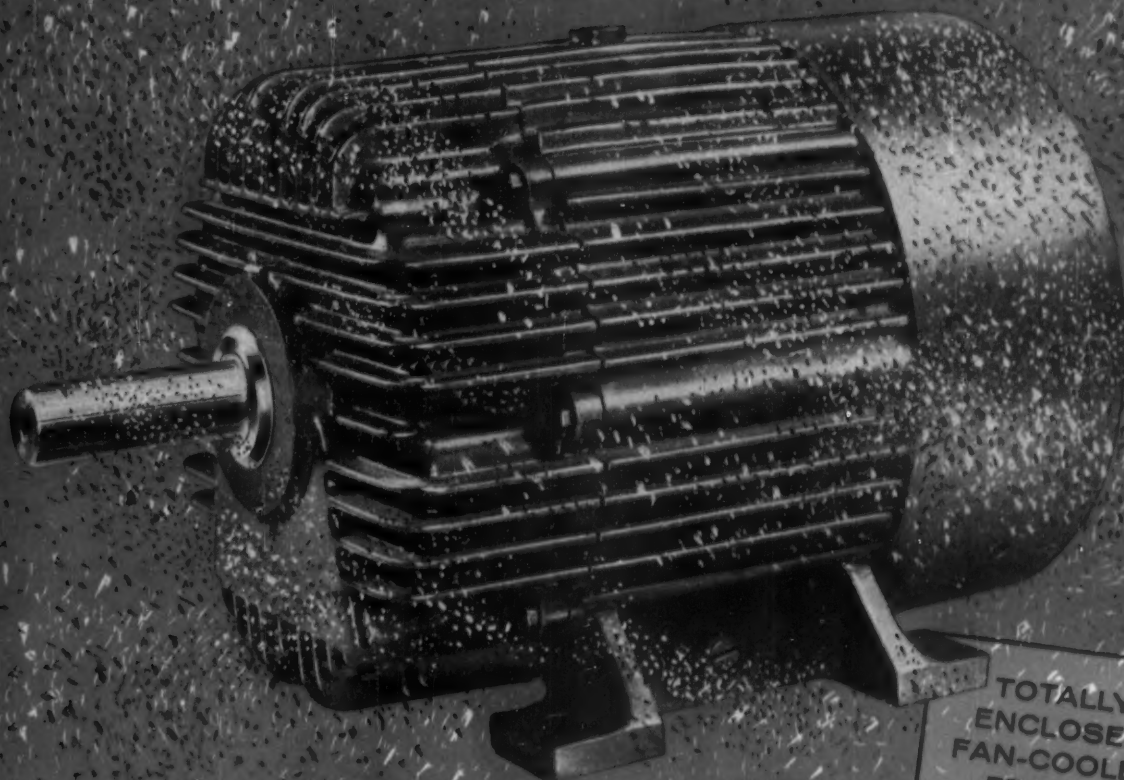
**THORNDALE, PENNSYLVANIA**

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*District Sales Offices in Principal Cities*



Inside and Outside . . . entirely **new**



**TOTALLY  
ENCLOSED  
FAN-COOLED  
FRAMES  
284U-326U**

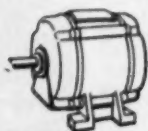
## **NEW Elliott C-W type N Motor PERMANENTLY SEALED Against Dust, Moisture, Corrosive Fumes**

The rugged "Sealedpower" cast frame Elliott motor shown above is the modern version of the design pioneered in this country by Crocker-Wheeler. An external fan, made of sparkless material, and surrounded by a cowl, blows air along the frame for highest cooling efficiency. An internal fan provides continuous air circulation within the enclosure. All openings in the frame are tightly sealed, providing complete protection to windings and working parts.

Once applied only in locations where extremely destructive atmospheric conditions prevail, totally-enclosed motors are today rapidly gaining acceptance for all types of applications. Users find that the total over-all cost—first cost plus maintenance—is less than that of open or semi-enclosed motors.

Ask your Elliott representative for details, or write for the new type N motor bulletin. Address Elliott Company, Crocker-Wheeler Division, Jeannette, Pennsylvania.

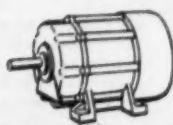
### **OTHER C-W TYPE N MOTOR ENCLOSURES**



**Totally-enclosed  
non-ventilated**



**Dripproof  
Protected**



**Totally-enclosed, fan-cooled  
Frames 256 U and smaller**

## **ELLIOTT Company** CROCKER-WHEELER DIVISION



We will be glad to send a copy of this new booklet describing the complete line of Elliott C-W type N motors. Please write on company letterhead.

W6-6







Photo courtesy Standard Oil Co., (N.J.)

## stay on stream longer with the **LJUNGSTROM® AIR PREHEATER**

Slag—primary cause of reduced capacity—can be substantially reduced by the Ljungstrom Air Preheater...to keep you on stream at top capacity months longer.

That's because preheated air mixes more thoroughly with fuel. The result is better combustion...and less slag-forming material present in the furnace. Oil tubes stay cleaner...stills stay on stream at top capacity for months longer. As an example, one pipe still in an eastern refinery dropped from 16,000 barrels a day to 12,000 because of slag. Now, with a Ljungstrom and modern high-temperature burners, the still operates continuously at 18,000/20,000 barrels.

### How fast is "WRITE OFF"?

By cutting turnaround time alone, the Ljungstrom means major savings for you. When you take the other Ljungstrom advantages into account—up to 20% fuel saving...more

economical furnace design, with no need for convection surfaces...burns many fuels you used to throw away...consistently higher through-put...higher product quality—you can see why a Ljungstrom is paid out in just a few months.

For more complete details on what the Ljungstrom Air Preheater can do for you...for an analysis of the heat recovery benefits attainable in fuel burning equipment—call or write The Air Preheater Corporation.

### Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

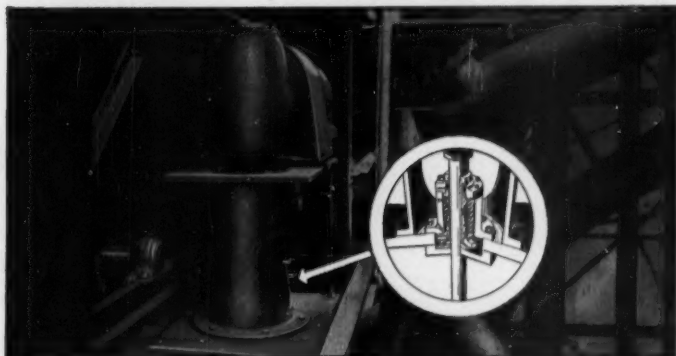


**The Air Preheater Corporation** 60 East 42nd Street, New York 17, N. Y.



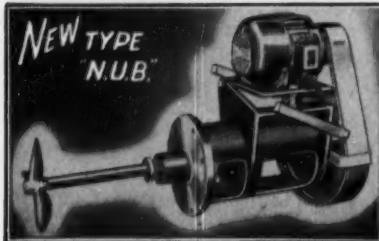
# International

## FIRST in Chemical Mixing and Processing



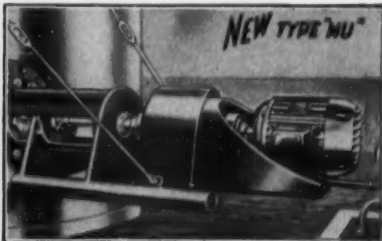
**TYPE "LFR" SLOW SPEED TURBINE TYPE MIXER — 1 to 100 H.P.**

Low Head Room—Speed Ranges 1 to 350 R.P.M.—Mechanical Efficiency 96 to 98½%—AGMA ratings—All steel gear housing—Equipped with Mechanical Seal or Standard Packed Stuffing Box—for open or closed tank operation.

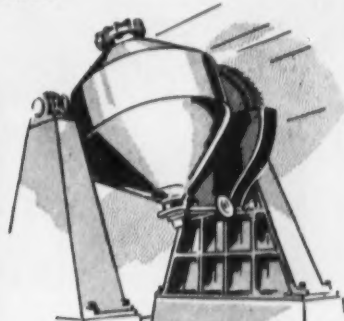


**SIDE ENTERING MIXERS—½ to 30 H.P.**

INTERNATIONAL can furnish either standard packed Stuffing Box or Mechanical Seals—On most standard types of Side Entering Mixers either Seal can readily be converted to the other, as desired.

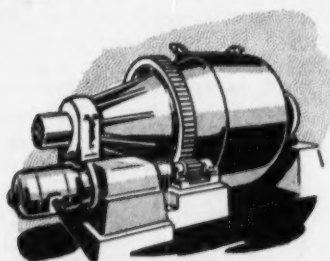


SHUT-OFF CONNECTION on Side Entering Mixers allows repacking or replacement with either Standard Stuffing Box or Mechanical Seals with a full head of liquid, without appreciable leakage.



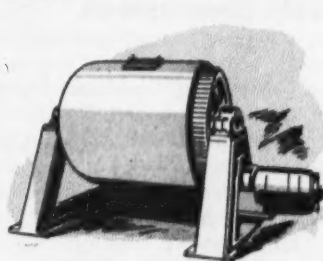
**CONICAL DRY BLENDERS**

Specially Engineered and adapted to your Product. INTERNATIONAL Conical Dry Blenders are the standard of Lower Blending Costs for Hundreds of Chemical Products. Standard sizes ranging in capacity from 25 to 10,000 lbs. for densities of from 20 to 100 lbs. per cu. ft.



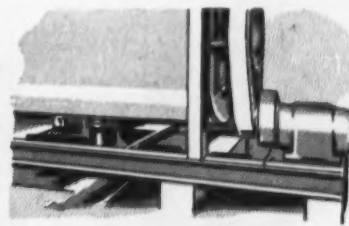
**CONTINUOUS CONICAL BALL MILL**

For Wet and Dry Grinding. Adapted to open or closed circuit operations. Welded Steel Construction, with high production and mechanical efficiency. Furnished in all standard sizes and capacities from 36" x 8" to 120" x 48" inclusive.



**PEBBLE AND BALL MILLS**

Of Welded Steel Construction, and furnished in all Standard Sizes from 18" x 24" to 96" x 144" inclusive, with 9 different drive arrangements. Equipped with Anti-Friction, Self-aligning Roller Bearings, reducing h.p. requirements by as much as 25%.



**RIBBON MIXERS**

INTERNATIONAL Ribbon Mixers are so designed that any desired proportion of various materials can be thoroughly mixed. Simplified Agitator Construction allows quick removal and easy cleaning. 16 Standard Sizes from ¼ to 175 cu. ft. capacity.

### Technical Bulletins Available

Top Entering Agitators... 73, 74, 76-A, 81  
Side Entering Agitators... 72-B  
Portable Mixers... 74-A  
Mixing & Extruding Machinery... 63-A  
Dry Blenders & Ribbon Mixers... 78  
Grinding & Milling Pans... 5  
Ball & Pebble Mills... 100-A, 100-B  
Laboratory & Pilot Plant Equipment... 77-A  
Stack Fans & Dust Boosters... 109-A

For the best in mixing and processing—consult

**INTERNATIONAL**  
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WO-rth 2-2580

DAYTON 1, OHIO

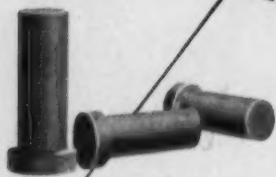
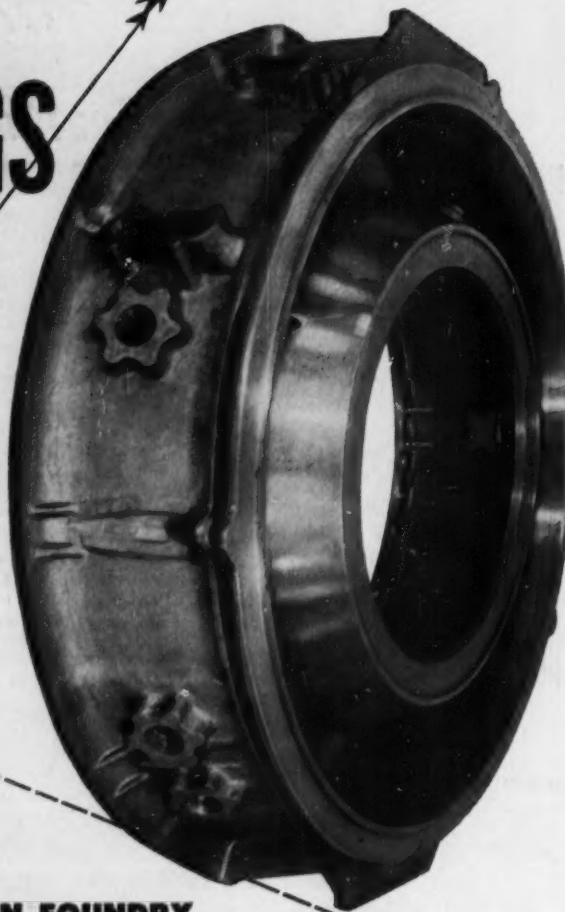
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SA-cramento 2-6750



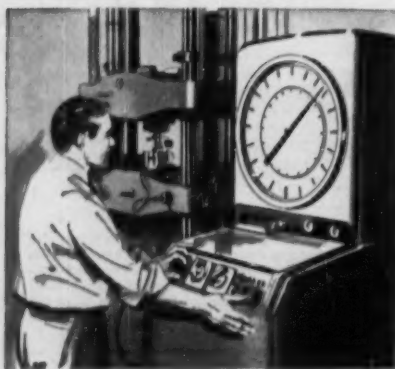
AIRCRAFT QUALITY

# ALLOY CASTINGS

*... for the special  
requirements of  
your industry*



**METALS PROCESSING DIVISION FOUNDRY**  
handles wide range of sizes,  
closely controls dimensions



Precision testing methods  
provide close control of  
casting quality

Curtiss-Wright's Metals Processing Division today offers your industry precision castings of critical parts in a wide variety of sizes, and with closely controlled dimensions. For example, in the large casting shown, tolerance is  $\pm .030$  over 36" diameter. From its modern, completely equipped foundry in Buffalo, the Division supplies heat, corrosion and abrasion resistant castings from a full range of special-property alloys, including ductile iron... by sand, centrif-

ugal, ceramic or shell processes.

Precision alloying techniques, modern melting controls with spectrometer testing, X-ray control by experienced radiographers — all add up to castings with superior physical and mechanical properties . . . mean better and more dependable products for the critical needs of industry. Qualified design engineering assistance is a part of the comprehensive Metals Processing Division service. Write for details.

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Metals Processing Division Branch Offices: New York • Houston • Los Angeles



# 60,000,000 BTU PROCESS HEAT PER HOUR



## A typical Struthers Wells CIRCULATING HEATING SYSTEM serving a major Canadian oil refinery

The Dowtherm heaters shown above are installed in the plant of a major Canadian oil refiner. The heaters are part of Struthers Wells circulating heating systems, utilizing liquid Dowtherm as the heating medium, at temperatures of approximately 700°F.

This equipment is used to supply process heat for reboilers and other heat transfer equipment, as installed in a modern lubricating oil refining operation. This type of equipment insures close temperature control and high heat transfer rates in the users. The

capacity of these systems is 60,000,000 BTU per hour, making it one of the largest installations of this type.

Struthers Wells is a major supplier of circulating heating systems for both liquid and vapor service, and utilizing commercial heat transfer fluids in a wide temperature range. Hundreds of successful installations, many of them repeat orders, provide a wide background on which to base recommendations for any type of service.

Fired heaters for the direct heating of process fluids, as gas, steam, and hydrocarbons, to the highest commercial temperature ranges are also built by Struthers Wells.

### STRUTHERS WELLS PRODUCTS

#### PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . .  
Evaporators . . . Heat Exchangers . . . Mixing  
and Blending Units . . . Quick Opening Doors  
. . . Special Carbon and Alloy Processing  
Vessels . . . Synthesis Converters

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BOILERS for Power and Heat . . . High and  
Low Pressure . . . Water Tube . . . Fire Tube . . .  
Package Units

#### FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic  
Cylinders . . . Shafting . . . Straightening and  
Back-up Rolls

#### MACHINERY DIVISION

MACHINERY for Sheet and Structural Metal  
Forming . . . Tangent Benders . . . Folding  
Machines . . . Roller Table and Tumble Die  
Bending Machines . . . Press Brakes . . . Punch-  
ing and Notching Machines . . . Forming Dies

## STRUTHERS WELLS Corporation

WARREN, PA.

**S**truthers  
**W**ells

Plants at Warren, Pa.  
and Titusville, Pa.

Offices in Principal Cities



IS YOUR CONVEYING SYSTEM

STAGGERING?



## the F-H Airslide®

can stabilize your  
conveying operation

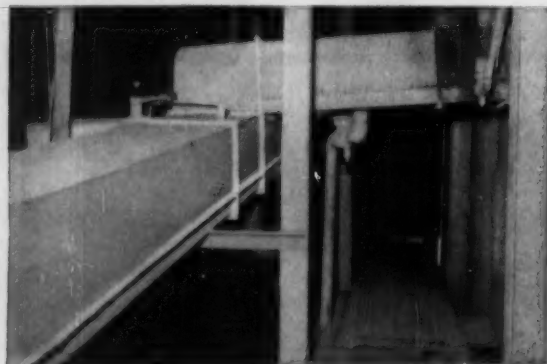
The phenomenal costs and waste that result from outdated and antiquated conveying systems can be, and have been, reduced to a gratifying minimum when the Fuller-Huron Airslide fluidizing conveyor comes into the picture.

The Airslide's record for low maintenance, high-volume conveying of dry, fine materials is outstanding wherever it is used . . . its operational benefits are substantial.

Low-pressure air is introduced into materials like alumina, phosphate, silica flour, cement, flour, filler dusts and many others, through a porous fabric, causing the material to flow in the upper section of the inclined Airslide, the degree of incline depending on the material to be conveyed. Further, the F-H Airslide can be used singly or in combination with other Fuller conveying systems, such as the Airveyor® or Fuller-Kinyon system.

Singly, or in combination with other Fuller conveying systems, you're bound to save more with the Airslide. The first step toward this goal is to call on Fuller. We'll be happy to provide you with details as well as a "no-obligation" example of how the Airslide can do your present conveying job better.

Write, right away, for descriptive Airslide literature.



# Fuller

pioneers in harnessing AIR

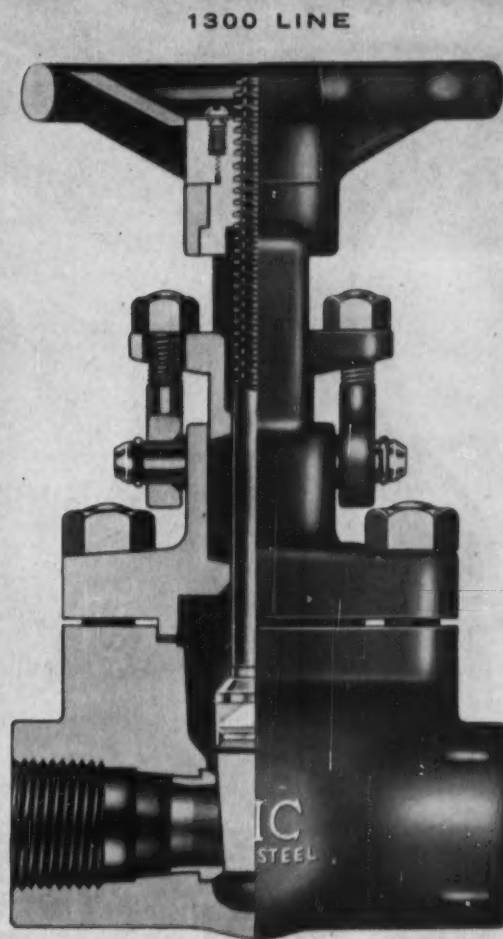
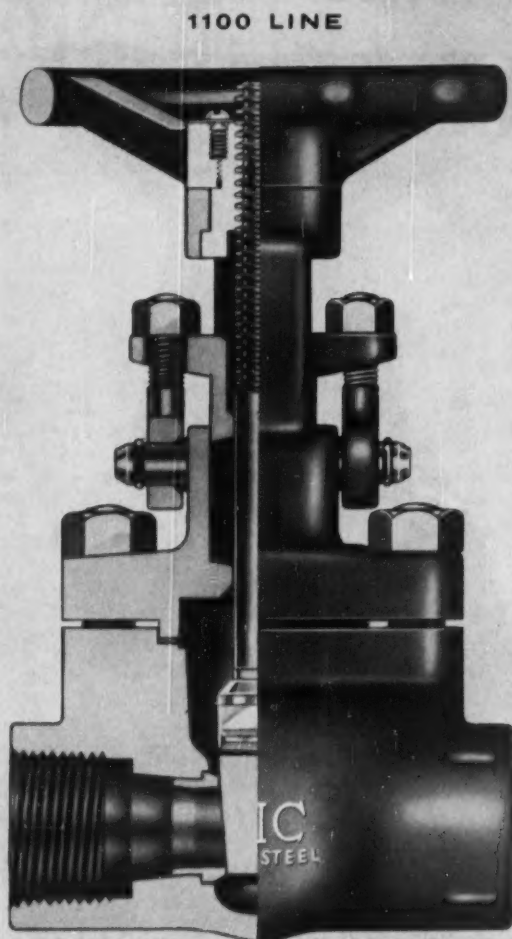
**FULLER COMPANY**

**134 Bridge St., Catasauqua, Pa.**

PH-45  
3017

SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION  
Chicago • San Francisco • Los Angeles • Seattle • Kansas City • Birmingham





New, OIC bolted bonnet, 600 lb. forged steel gate valve lines,  $\frac{1}{2}$ " to 2" with HCH, all purpose trim.

## 2 new rugged OIC forged steel lines



Both feature the modern and rugged bolted bonnet joint, which simplifies and lowers the cost of maintenance.

Both feature a soft iron gasket securely retained in the bolted male and female body-bonnet connection to assure enduring tightness.

Both feature 13% chrome stainless steel trim with 1000 Brinell, duracased wedges.

Both feature plenty of gripping area for pipe wrenches on pipe ends; there's no interference with body-bonnet flanges. Simplifies joint make-up!

The 1300 line includes a *high flow* port area, offering full-flow characteristics.

The 1100 line, with standard flow ports, is compact, economical, and includes the same high quality, rugged features and trim as the 1300 line.

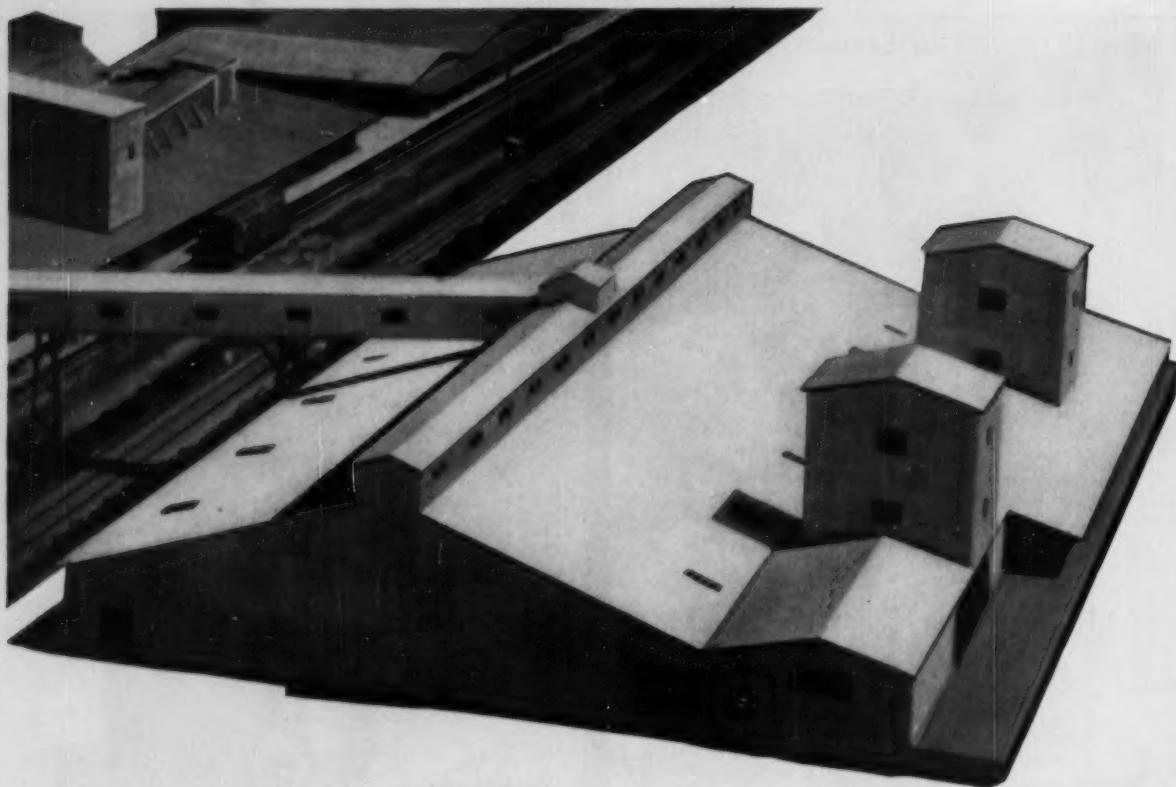
Most valve users have applications suited to both of these new OIC valve lines. Write for Bulletin #195-R illustrating features and specifications that fit these newest forged steel valves to your services.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

**V**ALVES

FORGED & CAST STEEL, LUBRICATED PLUG,  
BRONZE & IRON VALVES





## *Why Dixie Guano Company chooses Luria Buildings...*

Can standardized structures meet the complex requirements of the Chemical Industry? Luria provides the answer... in the affirmative!



At Dixie Guano, warehousing plays an important role. The bulk storage area included in this company's Luria Building has a capacity of 12,000 tons of fertilizer. Designed for maximum efficiency, it can be filled during seasonal lulls by a single man!

Transporting materials from processing plant to shipping center is easily accomplished with Luria's standardized overhead bridge which contains a swift moving, economical conveyor belt system.



These multi-story buildups by Luria dramatically prove how well standardized structures may be adapted to individual needs. Designed to meet Dixie Guano's requirements, the superstructures house special processing machinery.



"Customized" to your individual needs, "standardized" to bring speed and economy to your building program—these are just two of the many advantages provided by Luria structures. If you are planning expansion now or in the future, the list of companies who order—and reorder—Luria Buildings will impress you—just as the many advantages of Luria Buildings will interest you. Contact your Luria representative. It pays!

**LURIA ENGINEERING Company**  
511 FIFTH AVENUE, NEW YORK 17, NEW YORK    Plants: BETHLEHEM, PA. • CHICAGO HEIGHTS, ILL.  
District Offices: ATLANTA, BOSTON, PHILADELPHIA, CHICAGO, WASHINGTON, D.C., RICHMOND, PITTSBURGH



# High Speed Reduction to Micron Sizes — No Attritional Heat!

Production Model  
(15 in. diameter  
grinding chamber)

Laboratory Model  
(2 in. diameter  
grinding chamber.)

## ENGINEERING FLUID-JET GRINDING IN "PACKAGE UNITS"

... comes naturally to Sturtevant engineers — with their 75-year tradition of successful solving of dry-processing problems. If you want to accomplish the most effective grouping of a Micronizer\* Grinding Machine with necessary compressor, feeder and dust-collector, it will pay you to investigate. Check the coupon on the right for more information.

## Sturtevant Micronizer\* Grinding Machines Give Greater Finenesses than Tube or Roller Mills

Look at the record! 30 inch model reduced titanium dioxide to 1 micron and finer at solid feed rate of 2250 lbs. per hr. 24 inch model reduced DDT (50%) to 3.5 average microns — 1200-1400 lbs. per hr. 8 inch model reduced Procaine—Penicillin—to 5 to 20 microns—up to 20 lbs. per hr. Couldn't you use milling performances like these?

**No moving parts.** The particles grind each other. High-speed rotation and violent grinding impact of particles are caused by jets of compressed air or steam at angles to the periphery of the shallow grinding chamber. There are

no problems of attritional heat. Centrifugal force keeps over-sized particles in the grinding zone. Cyclone action in the central section classifies and collects the fines for bagging.

**Instant accessibility, easy cleaning.** Micronizer\* Grinding Machines come in seven sizes — each one constructed for quick accessibility and easy maintenance (typified by the "OPEN DOOR" design in other Sturtevant equipment). Grinding chambers range from the 2 in. laboratory size with ½ lb. per hr. capacity to the 30 in. size which handles up to 3000 lbs. per hr.

\* Registered trademark of Sturtevant Mill Co.

## STURTEVANT

### Dry Processing Equipment

The "OPEN DOOR" to lower operating costs over more years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS  
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

My dry-process materials are:

Desired capacity is:

Name \_\_\_\_\_ Title \_\_\_\_\_

Firm \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_

Zone \_\_\_\_\_ State \_\_\_\_\_

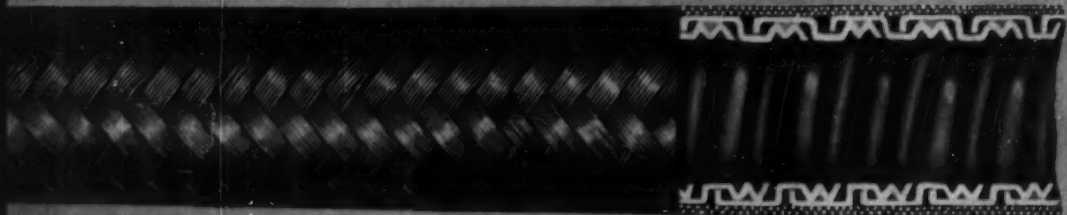
STURTEVANT MILL COMPANY 100 Clayton Street, Boston 22, Mass.

Please send me your Micronizer\* Bulletin ☐

Also bulletins on machines for:

- ☐ CRUSHING ☐ GRINDING ☐ PULVERIZING ☐ BLENDING ☐ MIXING ☐ CONVEYING
- ☐ SEPARATING ☐ GRANULATING ☐ SUPERFINE SELECTING

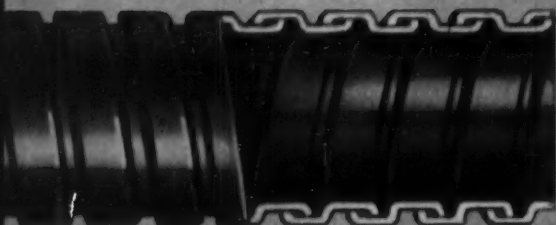




TYPE FP WIRE BRAIDED



HEAVY DUTY INTERLOCKED



LIGHTWEIGHT SQUARELOCKED  
Unpacked, cord packed, light asbestos  
packed, heavy asbestos packed



TWIN-LOK  
Galvanized Lined  
Stainless Steel Lined

## FLEXIBILITY

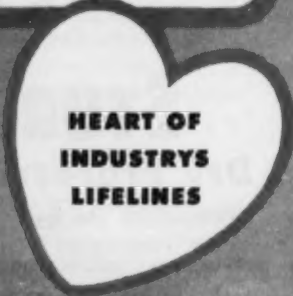
### DEFIES HEAT...FATIGUE ABRASION...LEAKAGE

Penflex is ruggedly built hose with all of the flexibility required, plus the toughness and durability of metal. No matter how hot the material to be conveyed Penflex cannot be cooked like ordinary hose. It stubbornly defies rough abuse, abrasion and crushing.

From 1/8" I.D. to 24" I.D. . . . bronze, galvanized steel, or stainless steel . . . from an air compressor line to a diesel exhaust, Penflex makes them all for the chemical industry. And Penflex "Flexineering"—the science of applying flexible tubing to fit the particular needs of the job to be done—assures the right tube in each installation. When you require tubing or hose that is tight as a pipe, but flexible . . . safe at high temperatures . . . and free from metal fatigue, specify Penflex.

Penflex manufactures a complete line of four wall interlocked and seamless welded corrugated flexible tubing for the chemical industry. Write for your free copy of the booklet "Flexineering At Work."

Pennsylvania Flexible Metallic Tubing Company, Inc.,  
7234 Powers Lane, Phila. 42, Pa. Branch Sales Offices:  
Boston • New York • Chicago • Houston • Cleveland  
Los Angeles and Distributors in Principal Cities

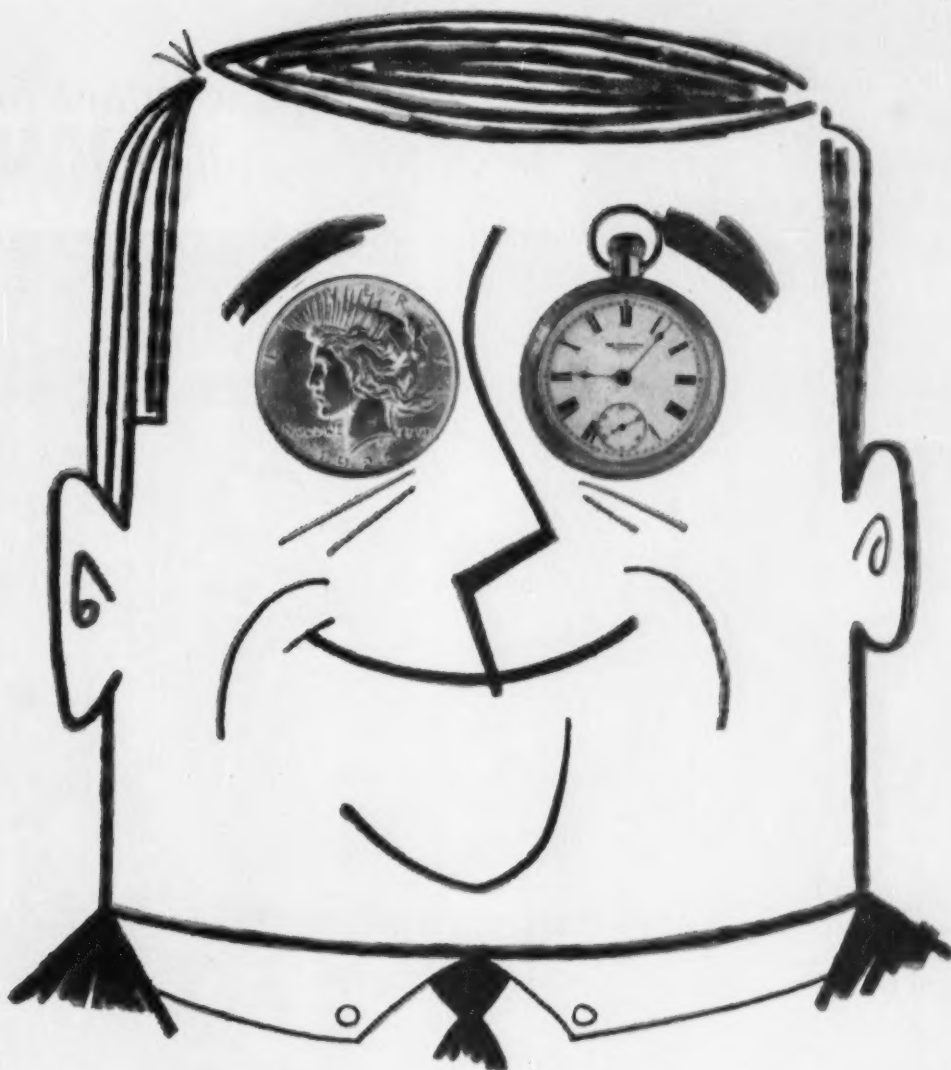


HEART OF  
INDUSTRIES  
LIFELINES

## METALLIC TUBING

# P E N F L E X





## TIME IS MONEY... SAVE BOTH!

ORDER NITROGEN PRODUCTS FROM SINCLAIR NOW

There are two big reasons why you should sign now with Sinclair for your supplies of nitrogen solutions, anhydrous ammonia and aqua ammonia.

First — the completion and opening of a centrally-situated new plant in Hammond, Indiana, means substantial savings in delivery time and shipping costs for most Mid-West nitrogen users.

Second — your seasonal supply problem can be solved by this plant's vast storage capacity... products will be delivered when you need them to meet your production schedule.

Let Sinclair help you solve your nitrogen supply problems and save you time and money in the bargain. Phone or write...

## SINCLAIR CHEMICALS, INC.

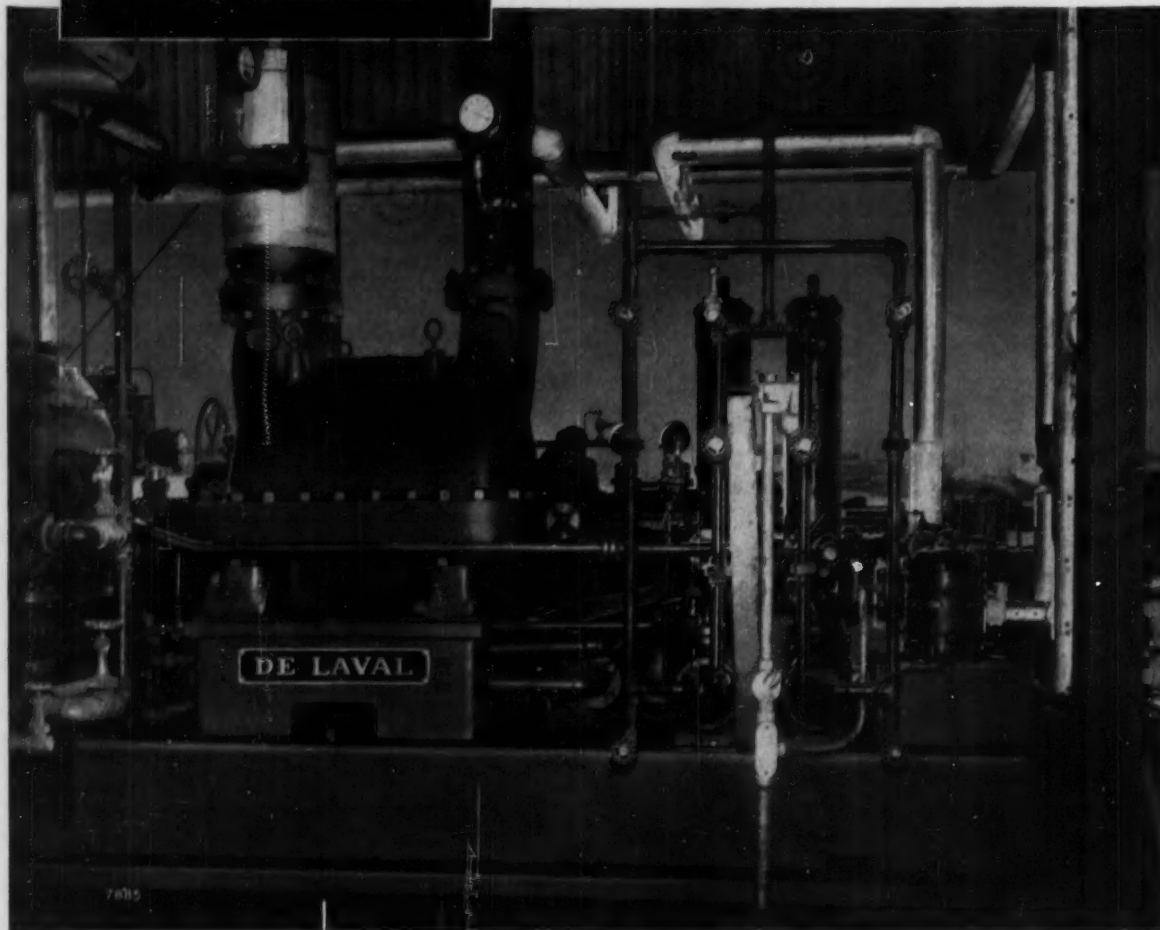
(Affiliate of Sinclair Refining Company)

600 Fifth Avenue, New York 20, N. Y. — Phone Circle 6-3600  
155 North Wacker Drive, Chicago 6, Illinois — Phone Financial 6-5900



**DE LAVAL**  
CENTRIFUGAL  
COMPRESSOR

*handles propane-butane for  
M. W. Kellogg alkylation unit*



*New Bulletin 0504  
gives complete data*

On stream at a plant of a large mid-western refiner, this De Laval unit compresses the propane-butane mixture to prepare it for an M. W. Kellogg alkylation unit.

Inlet volume of the De Laval centrifugal compressor is 3,040 cubic feet per minute. Inlet pressure is 18 psia, and discharge pressure 85 psia. This compressor is equipped with De Laval contact-type oil seals. The unit is driven by a 600 bhp turbine running at 7,400 rpm.

De Laval compressors are designed and built for heavy duty continuous operation. Rugged, horizontally split casings, individually designed impellers, perfectly balanced rotors and externally mounted, cylindrically seated bearings assure optimum performance and long service.



**DE LAVAL** Centrifugal Compressors

DE LAVAL STEAM TURBINE COMPANY  
803 Nottingham Way, Trenton 2, New Jersey

DL 309

326

December 1956—CHEMICAL ENGINEERING

LITHIUM METAL



# FOAMGLAS®

the cellular, stay-dry insulation

**STAYS DRY**—Here's how you can prove to yourself that FOAMGLAS does stay dry. Cut a piece from a FOAMGLAS sample. Place it in water. Note how its hermetically sealed glass cells keep it afloat. Weight it down for days, weeks or longer if you like. Remove the weight and it bobs back to the surface . . . proof that the sealed cells have absorbed no water—still have their original insulating efficiency.

**Wet insulation is no insulation . . .**

**Prove to yourself that FOAMGLAS stays dry!**

Send for a sample and test it!

Moisture conducts heat! When an insulation begins to absorb moisture, its efficiency nosedives. It's no longer an insulation.

That can't happen to FOAMGLAS. Every block of this unique insulating material is composed of millions of hermetically sealed glass cells. Each cell is an individual insulating unit . . . and each is watertight. Water and vapor are sealed out to insure constant insulating effectiveness.

In a few minutes, in your own office, you can prove to yourself that FOAMGLAS *stays dry*. Send today for a free sample and directions for simple "desk top tests" you can perform, as illustrated on this page. You'll soon see why it pays to insulate floors, walls, ceilings, roofs, piping and equipment with FOAMGLAS. You're assured constant, long-lasting insulating efficiency without the headache and expense of insulation replacement.

**Pittsburgh Corning Corporation**

Dept. H-126, One Gateway Center, Pittsburgh 22, Pa.

In Canada: 57 Bloor Street West, Toronto, Ontario



also manufacturers of PC Glass Blocks



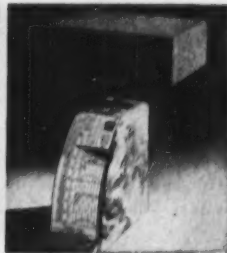
Vapor-proof



Strong and rigid



Inorganic and incombustible



Lightweight



## The "Wedaeplua Principle"



# LITHIUM METAL

*by the*

GRAM

*or*

**TON**

## Is your research specialty here?

The diverse physical properties and chemical reactions of lithium metal make it a uniquely valuable research tool. Consider these provocative uses:

- Alkyl- and aryl-lithium compounds, which are prepared from lithium metal, find wide application in synthetic organic chemistry. Use of methyllithium in the preparation of synthetic Vitamin A is a typical example.
- Lithium metal as a direct reducing agent now suggests an interesting potential.
- The polymerization of isoprene to "natural" rubber thru the catalytic medium of lithium metal dispersions is a new development.
- The military and peacetime uses of lithium metal in the field of heat transfer show great promise. Based on its low density, high heat capacity and high heat of fusion, lithium has no equal as a liquid metal coolant.
- Lithium metal is the starting material for the production of lithium hydride and, in turn, lithium amide and lithium aluminum hydride.
- Rocket and guided missile propellants utilize metallic "super-fuels." Many rely on complex compounds containing lithium metal or hydride. The key: lithium's tremendous reactivity.

Put lithium to work for you. Our banks of electrolytic cells can supply experimental grams or commercial tons of this admirably versatile metal. Write for details.

*... trends ahead in industrial applications for lithium*



**LITHIUM CORPORATION  
OF AMERICA, INC.**

2505 RAND TOWER, MINNEAPOLIS 2, MINN.

PROCESSORS OF LITHIUM METAL • METAL DERIVATIVES: Amide • Hydride  
SALTS: Bromide • Carbonate • Chloride • Hydroxide • SPECIAL COMPOUNDS:  
Aluminate • Borate • Borosilicate • Cobalite • Manganite • Molybdate • Silicate  
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BRANCH SALES OFFICES: New York • Pittsburgh • Chicago • MINES: Keystone,  
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City, North Carolina • RESEARCH LABORATORY: St. Louis Park, Minn.

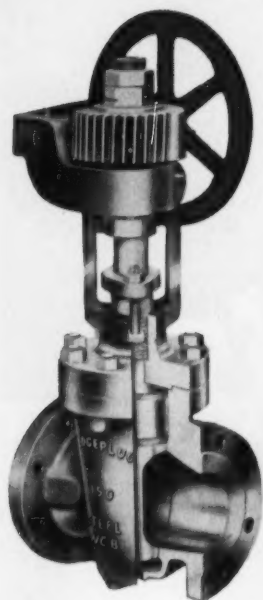




# The "Wedgeplug Principle" **ELIMINATES** *any need for* **PLUG LUBRICATION**

**LIFTS, TURNS, RE-SEATS  
IN ONE OPERATION**

- Wrench Operated
- Handwheel Operated
- Worm Gear Operated



**WEDGEPLUG**  
NON-LUBRICATED  
STEEL PLUG VALVES

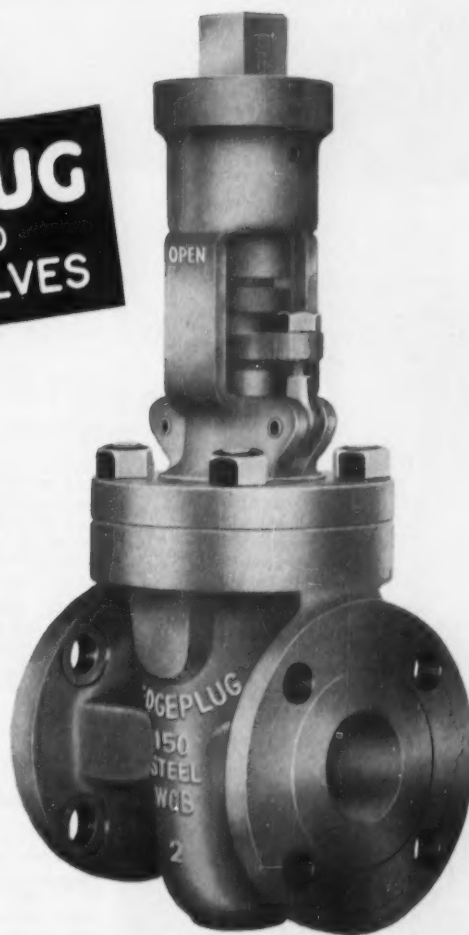
The "Wedgeplug Principle"—lift, turn, and re-seat—assures the quick, positive, trouble-free action of Wedgeplug Non-Lubricated Steel Plug Valves at a wide range of temperatures—from Petroleum "Cat Cracking" to the handling of Liquid Oxygen. The ability to perform satisfactorily at these extreme temperatures gives double assurance that Wedgeplug Valves will be trouble-free in ordinary service. And, the fact that the plug is non-lubricated is an extra safeguard against contamination, wherever this is a factor.

**WEDGEPLUG VALVE COMPANY, INC.**

*An Affiliate of*

**STOCKHAM VALVES & FITTINGS**

GENERAL OFFICES AND PLANT • BIRMINGHAM 2, ALA.



**WEDGEPLUG PERFORMANCE SAVES MONEY FOR YOU**



STANDARD OPEN DRIP-PROOF  
LOUIS ALLIS MOTOR

PLASTIC SHIELD COVERS FLYWHEEL  
TO PREVENT SPLASHING

MOTOR IMMERSSED IN WATER

## In water 1½ years...still running

Dramatic proof that Louis Allis motor insulation  
provides unusual moisture resistance

We wouldn't do this to a motor. But somebody did, to check our new insulation. They took a standard open drip-proof motor, placed it in water up to the shaft, and ran it a year and a half.

The motor will still run, too, which proves that our insulating materials are of top quality. One of our exclusive features is the new phenolic impregnating varnish we use. As you

can see, this varnish resists moisture, but it also has excellent thermal and chemical resistance and is not susceptible to embrittlement.

Insulation usually determines the life of a motor. That's why the insulating materials used in the new L. A. line are the product of years of continuous research and development. That's why Louis Allis motors run longer . . . give less trouble.

Find out the many other advantages available to you in the new L. A. line of motors. Write for our new bulletin No. 1700.



A complete line of standard rated motors in frames 182 through 326U now in stock. Special rated motors are available on short delivery.

LA-107



**THE LOUIS ALLIS CO.**  
MILWAUKEE 7, WISCONSIN



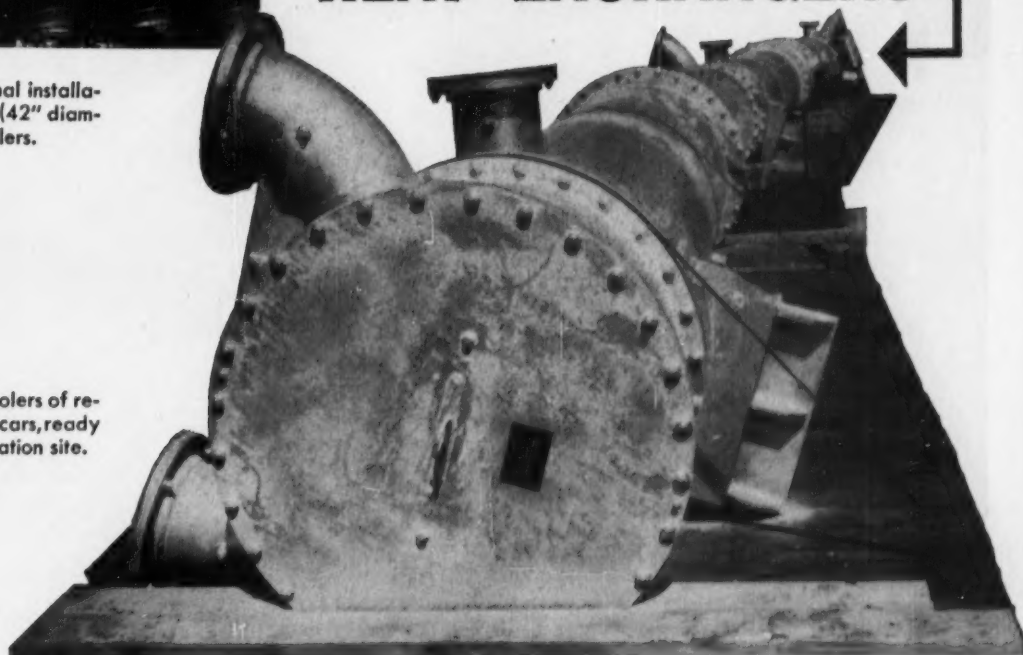


Partial view of original installation shows 5 parallel (42" diameter x 18') liquor coolers.

**This job WELL DONE**

**brought this  
REPEAT ORDER**

**of National-U.S. Shell and Tube  
HEAT EXCHANGERS**



Several completed coolers of repeat order loaded on cars, ready for shipment to installation site.

Complete satisfaction of a prominent steel producer with a recent installation of Shell and Tube Heat Exchangers (including wash oil preheaters and liquor coolers) has merited a repeat order from this valued customer.

### Reasons?

- Individually designed to purchaser's specifications.
- Built with quality materials.
- Fabricated on highest standards of workmanship.
- Engineered for safe, long, trouble-free performance with minimum maintenance.

*Write for Catalog HT-40—includes engineering service and procedure data*

HEAT TRANSFER DIVISION

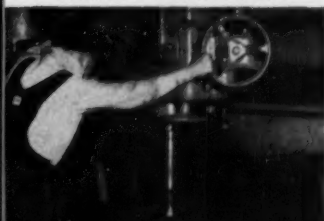


**National - U.S. Radiator**

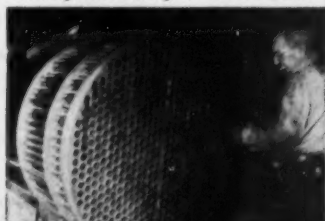
C O R P O R A T I O N

HEAT TRANSFER DIVISION HEADQUARTERS, 342 Madison Avenue, New York 17, New York

Start of drilling hundreds of accurately machined holes in tube sheet.



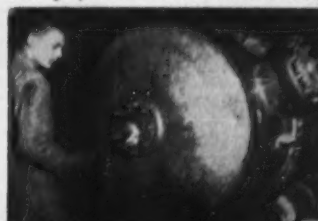
Rolling tubes in large size tube bundle.



Welding on a supporting bracket.



Testing operation on the finished cooler.







## Keep plant space flexible with **BLAW-KNOX Electroforged® Steel Grating**

If expanding production set-ups are cramping feeder and storage areas in your plant, it will pay you to check into Blaw-Knox Electroforged Steel Grating.

Storage platforms of Blaw-Knox steel grating put unused space to work easily, economically. There's nothing to wear, nothing to patch. Blaw-Knox Electroforged grating fits neatly around pipes, beams and machinery without any alterations to the building,

and, at the same time, admits maximum light and ventilation to the entire area.

Blaw-Knox Electroforged Grating for walkways, stair treads and floors is fabricated to your specifications to meet your own operating conditions. Complete data on all types is contained in Bulletin No. 2486. Write for your copy today.



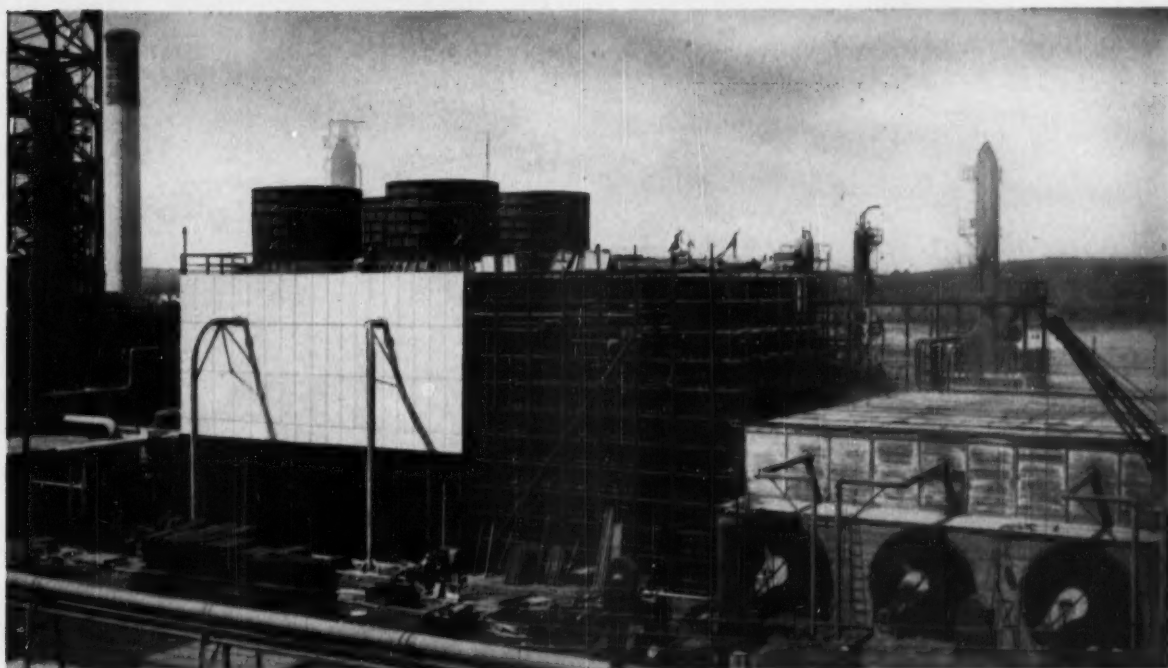
### **BLAW-KNOX COMPANY** Equipment Division


1103 Blaw-Knox Building, 300 Sixth Avenue  
Pittsburgh 22, Pennsylvania





# MORE COLD WATER for D-X Sunray



New  Cooling Tower replaces original forced-draft installation—gives 80% more cooling capacity on same foundation

A NEW eighteen cell Foster Wheeler induced draft cooling tower is shown at the left, above, during construction at the West Tulsa refinery of D-X Sunray Oil Company.

The tower was built in sections over the basin previously used for a Foster Wheeler forced draft tower shown at the right. New cells were put on stream as completed and the remaining cells of the old tower continued to operate until demolished. In this way the heat load was carried successfully through the summer without any shut-down during erection.

The new induced draft cooling tower, occu-

pying the *same* ground area, has 80% more cooling capacity than did the original forced draft installation.

The high cooling efficiency, low drift losses and rugged, all-redwood construction of the completely new line of FW induced draft cooling towers mean lasting economy and dependability in year-round service.

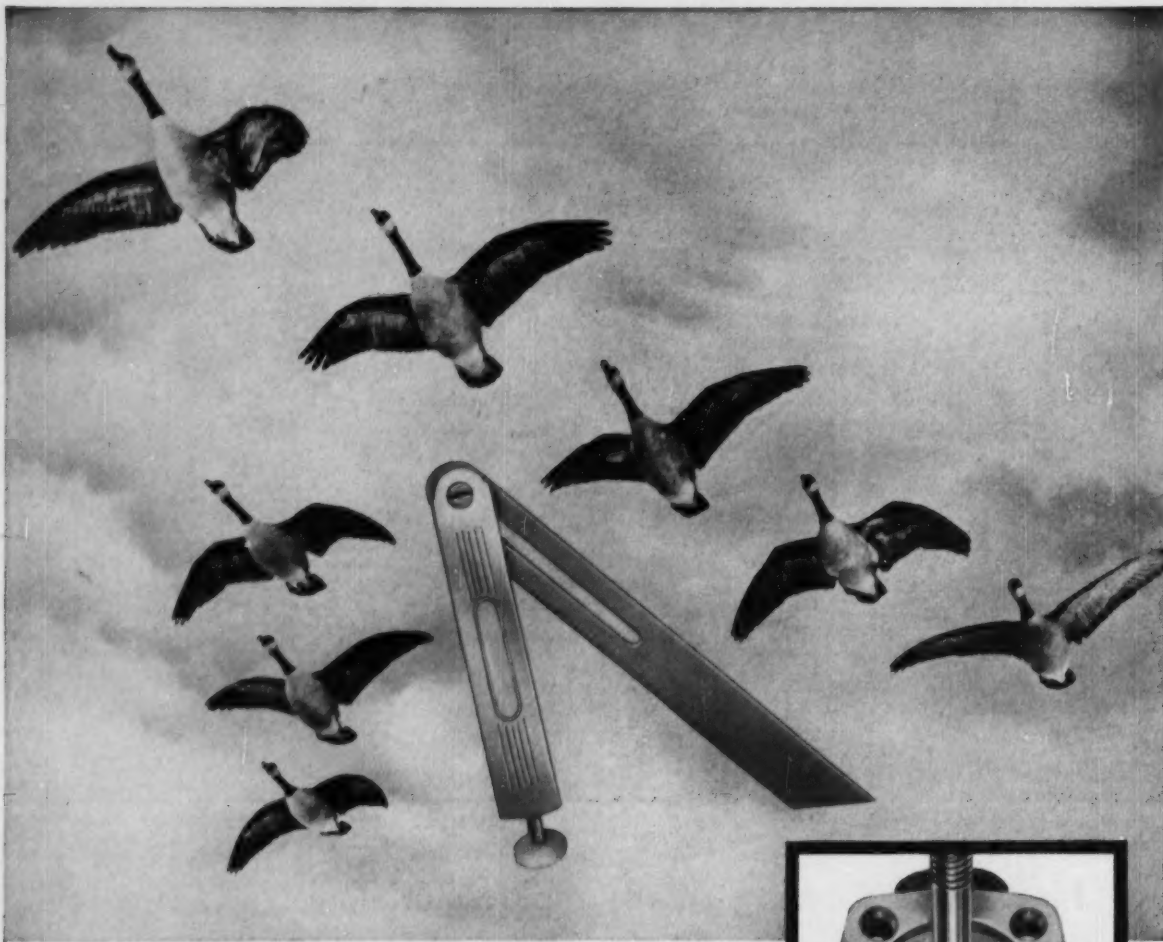
For complete information, send for a copy of new Bulletin No. CT-56-11. Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.



## FOSTER WHEELER

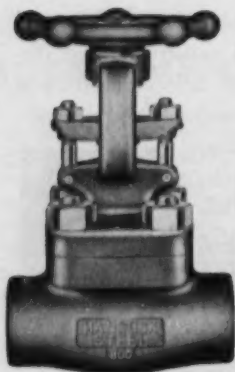
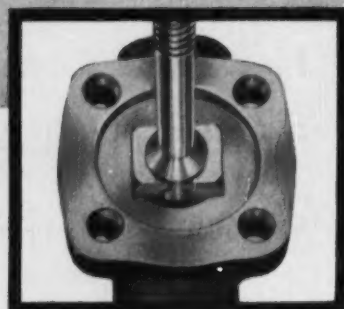
NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.





# GUIDE-ABILITY

that means longer life



FULL GUIDING in the Type 950 Hancock Steel Gate Valve does not permit the wedge to gall, scuff, chip or wear the seating surfaces. Four accurately-machined grooves in the valve body guide the wedge to and from the seats and prevent wedge rotation. No matter how great the flow and pressure load or the rotating force exerted by turning the handwheel, the wedge corners do not hit or rub across the seating surfaces. This close-clearance guiding protects against seat damage that frequently causes other valves to leak in as few as one opening-and-closing operation at service pressures.

The provision for precise full guiding adheres to the principle that valve seats and wedges *should wear from long service, not from battering against each other*. It is one of many quality features that keep Type 950 Hancock Steel Gate Valves in the line longer. Your Industrial Supply Distributor will gladly demonstrate. Phone him today.

## HANCOCK VALVES

A product of  
**MANNING, MAXWELL & MOORE, INC.**

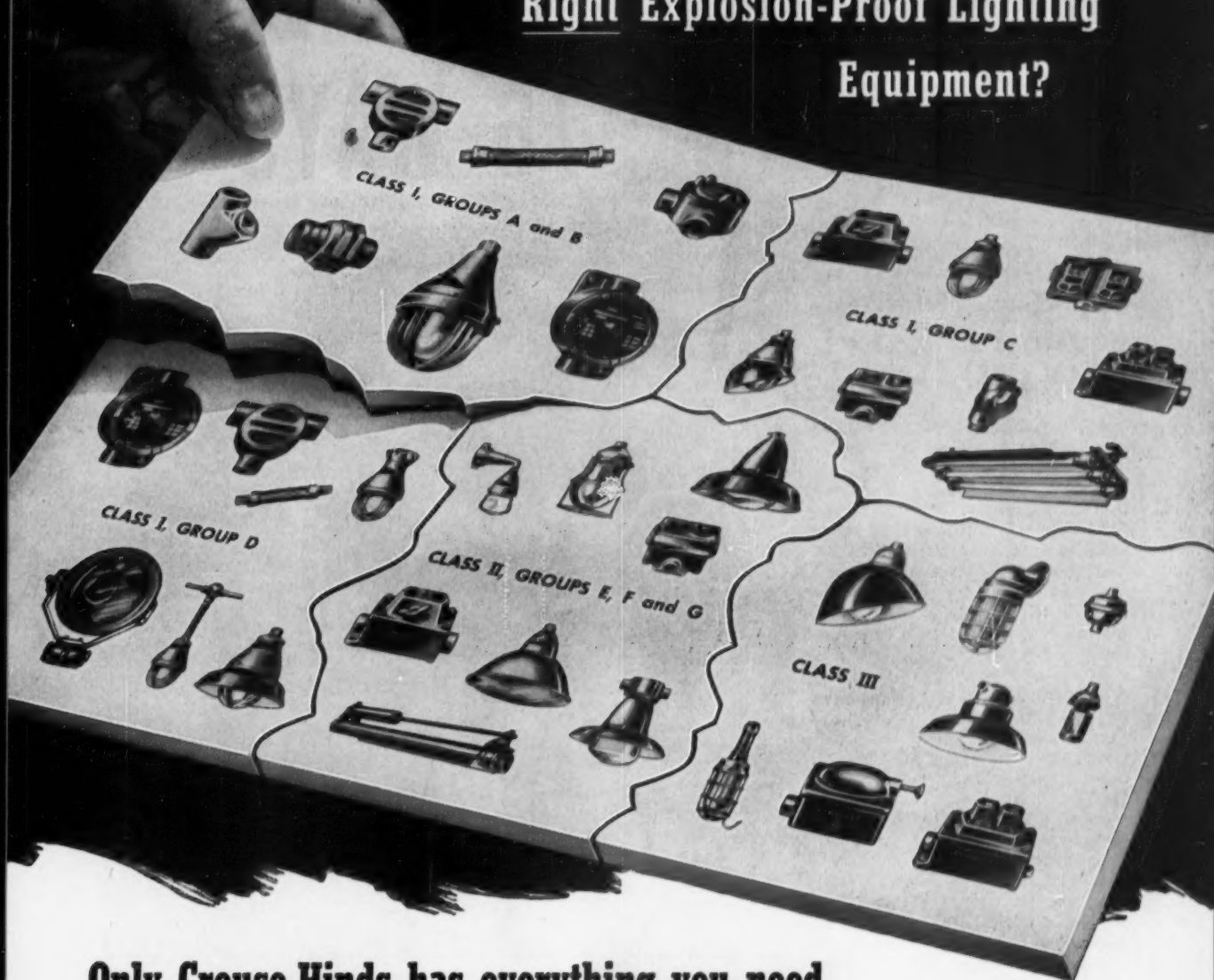
Watertown 72, Massachusetts

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario





# Puzzled about getting the Right Explosion-Proof Lighting Equipment?



**Only Crouse-Hinds has everything you need**

**...in every class ...in every group!**

For complete protection when making lighting installations in hazardous locations you need more than explosion-proof or dust-tight lighting fixtures. You also need UL-listed explosion-proof switches, junctions, fixture supports, unions and seals.

Crouse-Hinds now offers a broad selection of Condulet\* explosion-proof lighting equipment for Class I, Groups A and B locations. In fact, you can specify complete Crouse-Hinds explosion-proof lighting

installations, all UL-listed, no matter what class or group of Article 500 of the National Electrical Code is involved.

The same holds true for the entire Crouse-Hinds Condulet line of more than 15,000 conventional and explosion-proof items. With the broadest line in the field, Crouse-Hinds recommends *exactly* what you need . . . and *only* what you need.

A nearby Crouse-Hinds distributor will be glad to discuss your explosion-proofing problems and make recommendations without obligation.



\*Registered Trade-Mark

## CROUSE-HINDS COMPANY

Main Office and Factory: Syracuse, N. Y.  
Crouse-Hinds Company of Canada, Ltd.: Toronto, Ont.

OFFICES: Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Corpus Christi, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Louis, St. Paul, San Francisco, Seattle, Tulsa, Washington. RESIDENT REPRESENTATIVES: Albany, Atlanta, Baltimore, Baton Rouge, Charlotte, Chattanooga, Jacksonville, Reading, Pa., Richmond, Va., Silver Spring.



# NEW CONTROLLER LINE ADAPTS 576 WAYS

## Fenwal Announces Low-Cost Temperature Indicating Controllers

ASHLAND, MASS. — Fenwal Inc., has announced here that tailor-made, accurate, low-cost temperature indicating controllers are now available from stock.

Tailor-mades from stock are made possible by the development of the new Fenwal Series 541 line. The Series 541 is a standardized line of matched temperature indicating controller parts which can be combined easily in 576 ways.

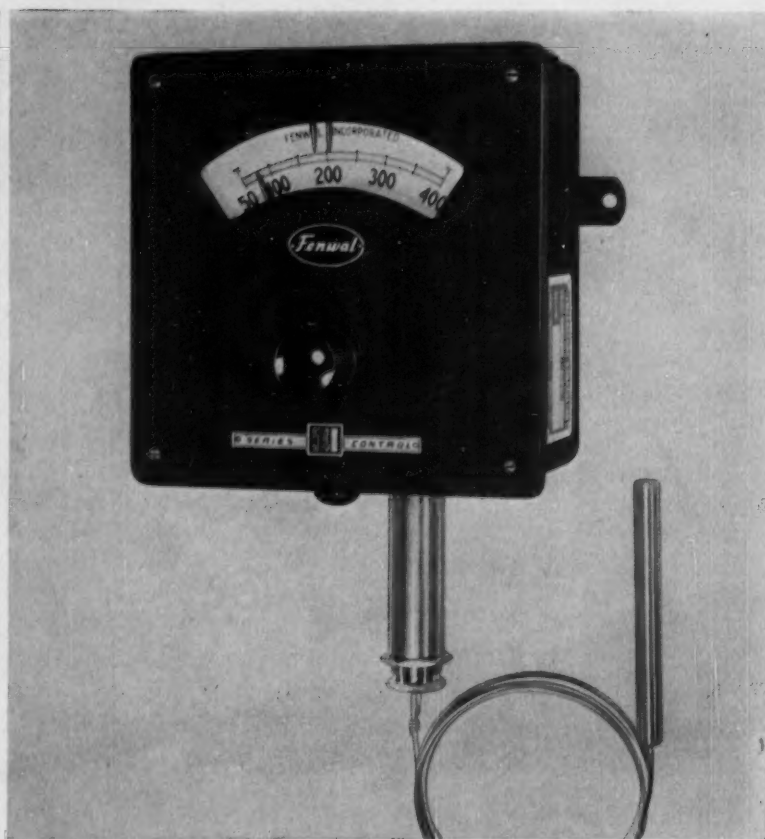
From these possible combinations come perfect solutions to countless temperature control problems. A prospective user lists the characteristics of the ideal temperature indicating controller for his particular operation, and Fenwal assembles an instrument with those characteristics from parts in stock.

No matter what combination is chosen, the result is a rugged, accurate, compact and easily maintained unit in a shock-proof, splash-proof, dust-proof housing. The housing is available in colors to match any equipment in which it may be installed.

Installation and calibration are so simple that instrument technicians and laboratory procedures are unnecessary. And, after installation, all normal temperature adjustments are external.

No matter what combination is chosen, the resulting instrument is accurate to within one per cent of scale. The accuracy is long lasting, with few moving parts and no internal gears. Simplicity of design brings the wear factor close to zero.

Series 541 offers single or double circuit control. There is a choice of four different long-life snap switches, with ratings up to 20 amps, 250 volts, A.C. These switches, singly or in combination, can provide a wide



One of Fenwal's new Series 541, bulb-and-capillary controllers. Photo shows dual circuit model which has two snap switches, each with a setpoint indicator, that actuate two separate circuits at the pre-set temperatures.

variety of operating characteristics.

Three stainless steel bulb types are available at no increase in price to meet space or process requirements. Capillaries and bulbs are corrosion-proof. Capillaries are swivel-mounted to protect them from breakage.

There is a choice of three temperature ranges:  $-150^{\circ}$  to  $200^{\circ}\text{F}$ ,  $50^{\circ}$  to  $400^{\circ}\text{F}$ , or  $50^{\circ}$  to  $700^{\circ}\text{F}$ , or their centigrade equivalents. Special ranges are available on request.

The control mechanism may be subjected to temperatures up to  $150^{\circ}\text{F}$ , and is ambient compensated from  $50^{\circ}$  to  $150^{\circ}\text{F}$ .

Write to Fenwal Incorporated, 1612 Pleasant Street, Ashland, Mass. Describe the tailor-made temperature indicating controller that would fit your operation perfectly. Chances are excellent that the tailor-made can be yours — at savings never before possible.



**CONTROLS TEMPERATURE  
... PRECISELY**



# 120 TONS OF UREA PER DAY from Turba-Film Processor at Sohio Petrochemical Plant

The Turba-Film® Processor has important advantages over conventional equipment in this application.

**90% solids produced quickly, economically and continuously...**

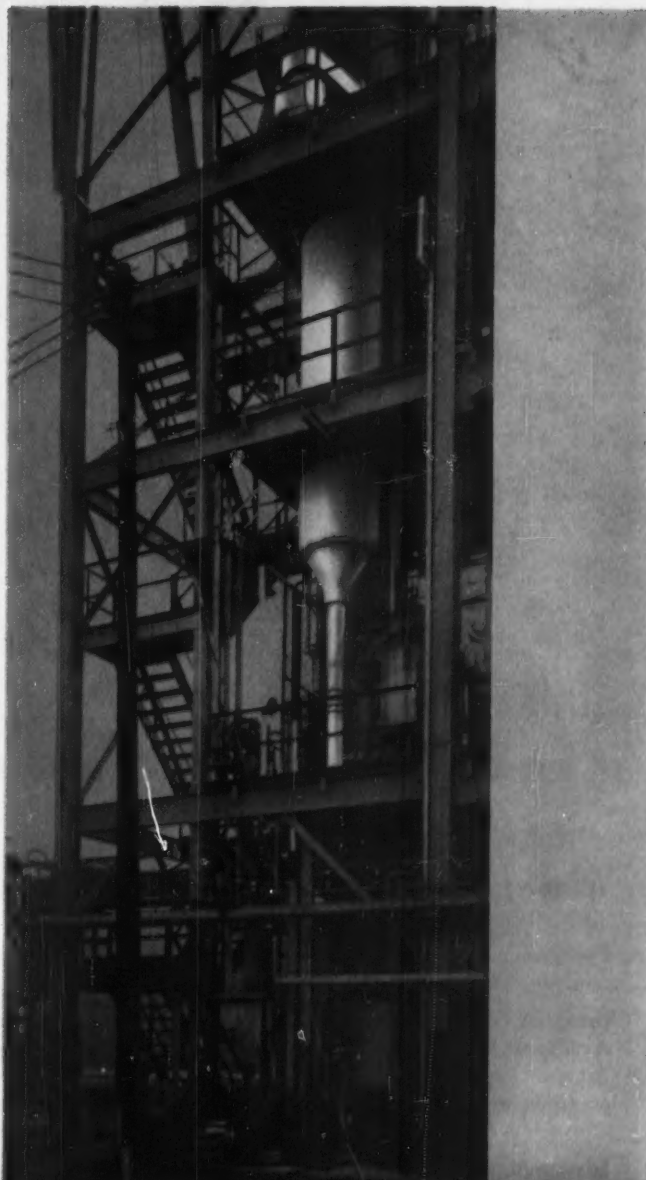
**Relatively low temperature prevents degradation of the urea.**

**Low operating cost, unfailing reliability, and simple operation.**

The Vulcan Inventa process, used by Sohio, overcomes two major difficulties which have hampered urea production: (1) Rapid and severe corrosion in the reactor where ammonia and carbon dioxide are combined under high temperature, and (2) difficulty of separating the unreacted carbon dioxide and ammonia. The Turba-Film Processor plays an important part in the system.

The No. 6 Turba-Film Processor constructed of Type 304 stainless steel dehydrates the urea solution and controls the biuret content. From the Turba-Film Processor, urea goes to the prilling tower, is then bagged or packaged. The total output is uniformly high grade urea.

Rodney Hunt Machine Co.'s Process Equipment Division is prepared to engineer, fabricate and erect complete package-type systems involving application of the Turba-Film Processor in continuous processing. Write for full information or telephone collect.



**RODNEY HUNT MACHINE CO.**

Process Equipment Division

31 Vele Street, Orange, Massachusetts, U. S. A.

**RODNEY  
HUNT**





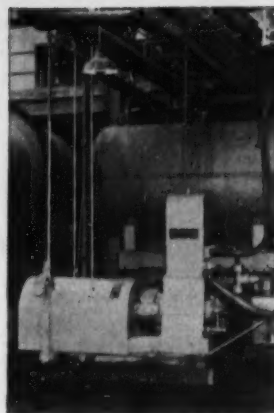
## What you need here is an ALDRICH PUMP

Corrosion, abrasion, high viscosity and high pressures are *not* always problems. Not when the pump is an Aldrich.

**Long life.** Aldrich Pumps take punishing service, year after year. Available in aluminum bronze, stainless steel, Hastelloy and titanium, Aldrich fluid ends handle all types of liquids—nitric acid, caustic solutions, fatty acids, acetic acid, aqua ammonia, anhydrous ammonia and many more.

**Easy maintenance.** Fluid end sectionalization, with changeable plunger sizes and interchangeability of parts, means fast, easy maintenance. Parts can be replaced easily and quickly, at low cost. Valves can be removed for inspection without special tools or equipment. Individual sections of the fluid end can be replaced at a fraction of the cost of conventional type fluid ends.

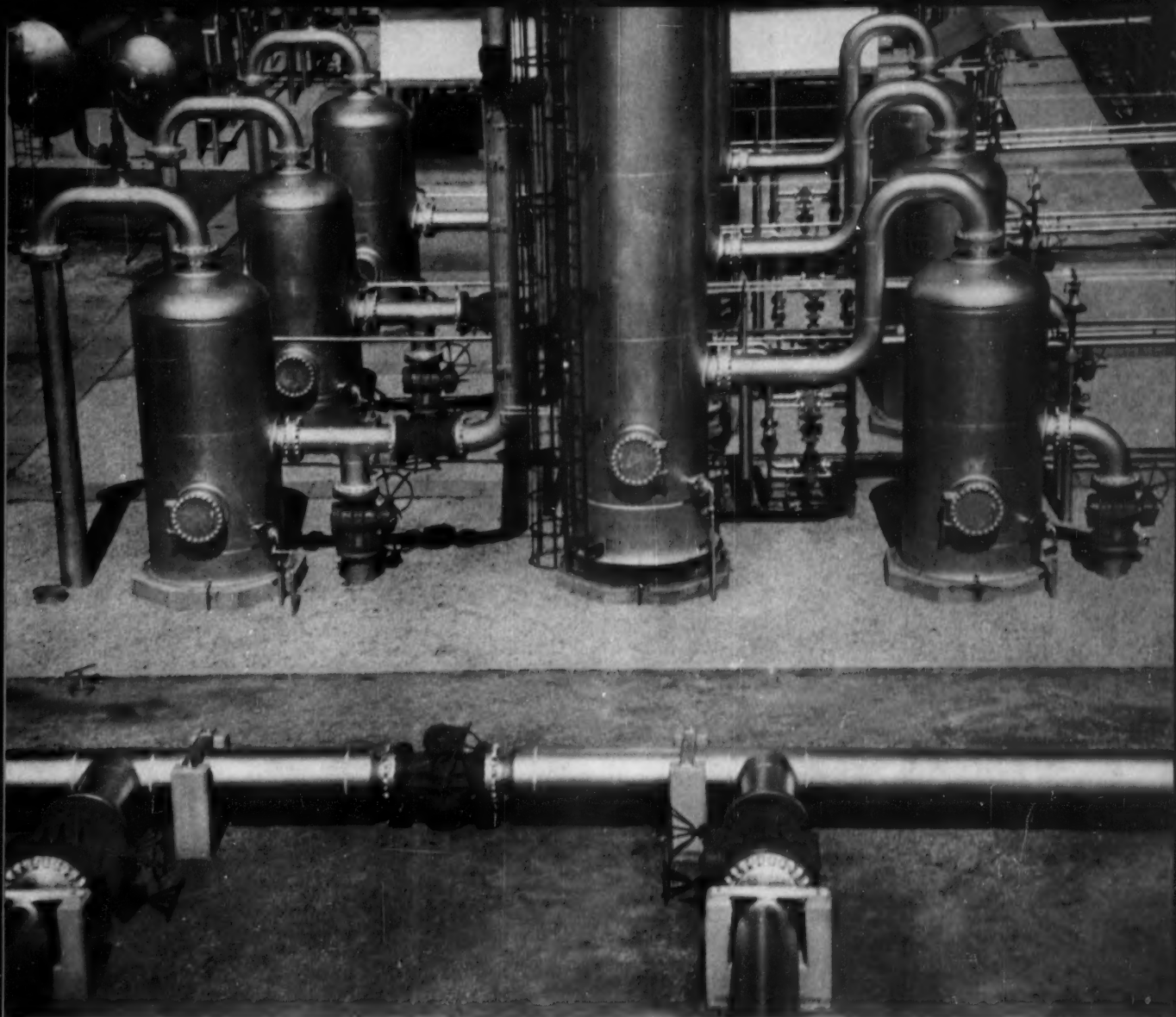
**Send for details.** For your tough pumping problems, it pays to specify Aldrich. Write for your copy of Data Sheet 100, a condensed catalog and selection table covering our entire line. The Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.



This Aldrich Triplex Pump in explosives plant, pumps nitric acid at 185 lbs./min. against 400 psi maximum pressure. Aldrich Pumps are available in 25 to 2400 hp.

THE  
  
 PUMP COMPANY





## *How much does safety cost?*

You don't pay extra for the inherent safety of Rockwell-Nordstrom valves. Actually, their price is often lower than ordinary valves. Their cost to use, year after year, is much lower because lubricant stops trouble before it starts.

Forty years of outstanding performance have proven you can't buy a safer valve than Rockwell-Nordstrom. Pressurized lubricant sealing

means positive, leakproof control on lightest gases. Streamlined thru-port design minimizes pressure loss on even heavy slurries. Quarter-turn operation is two to five times faster than ordinary valves. You *know* you are safe when you specify Rockwell-Nordstrom valves. Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

*Available at leading suppliers... everywhere.*

## **ROCKWELL-Nordstrom VALVES**

**Lubricant Sealed for Positive Shut-off**

**40<sup>th</sup> Year** of lubricated plug valve leadership







## *For power operation . . . clearly superior*

Rockwell-Nordstrom valves' quarter-turn operation allows the use of less complicated (and less costly) operators. Lubrication greatly reduces torque. The thin, tough film of *presurized* lubricant that forms the leakproof seal also cuts maintenance and down time by stopping trouble before it starts.

For electric, pneumatic or cylinder operation, Rockwell-Nordstrom valves perform better, longer, for less money. For more information, write: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

*Available at leading suppliers...everywhere.*

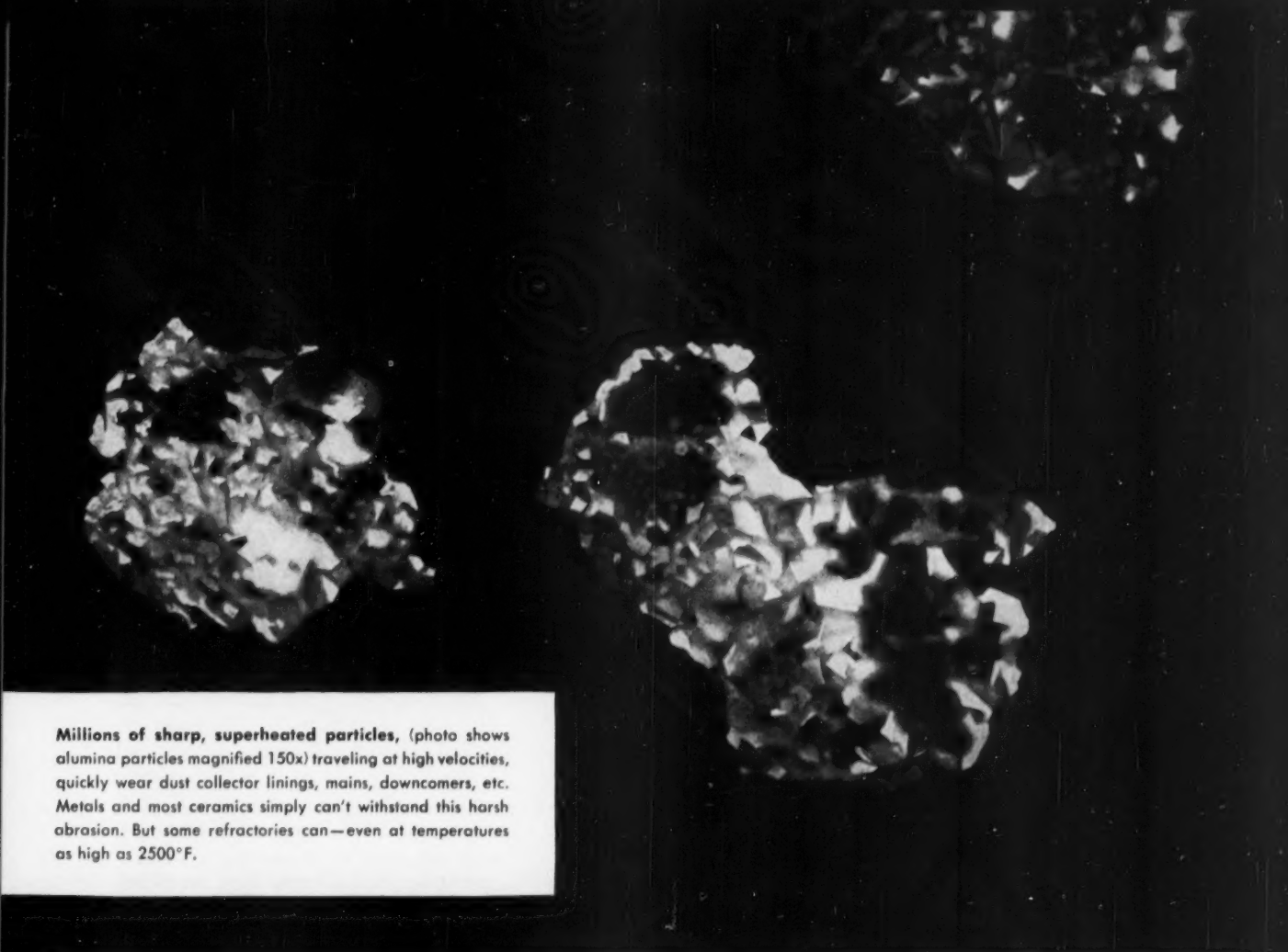
## **ROCKWELL-Nordstrom VALVES**

**Lubricant Sealed for Positive Shut-off**

**40<sup>th</sup> Year** of lubricated plug valve leadership







Millions of sharp, superheated particles, (photo shows alumina particles magnified 150x) traveling at high velocities, quickly wear dust collector linings, mains, downcomers, etc. Metals and most ceramics simply can't withstand this harsh abrasion. But some refractories can—even at temperatures as high as 2500°F.

## Refractories...where abrasion is a problem

**Unequalled resistance to abrasion** whether caused by tiny gas-borne particles or sliding steel billets—is one of the most useful properties of CARBOFRAX® silicon carbide refractories. For example, a CARBOFRAX dust collector lining on an ore sintering machine is still in use after 10 years service.

And when abrasion is combined with high temperature, the exceptional resistance of CARBOFRAX super refractories becomes even more apparent and useful. When used in the exhaust lines of gasoline catalytic cracking units in temperatures ranging around 1200°F, these refractories lasted 3 years, as compared to alloy rings which lasted for 6 months. On a gas fired extrusion mill furnace—where steel skids lasted 5 weeks—CARBOFRAX refractories lasted 156 weeks.

Wear resistance is not the only unusual property of these refractories. They also offer heat conductivity roughly 11 times that of fireclay, with sufficient hot strength to withstand 25 psi at 1720°C. CARBOFRAX refractories are but one of many super refractories pioneered by Carborundum and offering a wide range of unusual properties.

Carborundum's new magazine "Refractories" pinpoints many practical applications for these unusual products. The forthcoming issue carries a feature article on "Wear Resistance". Send for your copy today.

### CARBORUNDUM

Registered Trade Mark

#### VALUABLE INFORMATION FOR USERS OF:

REFRATORIES • CASTABLE CEMENTS • POROUS PLATES AND TUBES

CATALYST SUPPORTS • OXIDE, BORIDE, NITRIDE AND CARBIDE

HIGH-TEMPERATURE MATERIALS • CERAMIC FIBER

*all in the new magazine "Refractories"*

#### MAIL THIS COUPON TODAY

Dept. H126, Refractories Division  
The Carborundum Company, Perth Amboy, N. J.

Please send me the forthcoming issue of "Refractories".

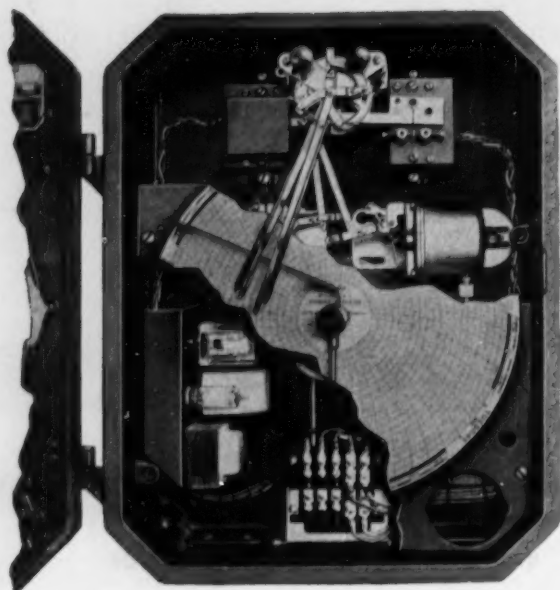
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# NEW

# ELECTRONIC CONTACT CONTROLLER

BY *Taylor*



## FEATURES

- Changing Resistor-Capacitor Can gives Single Point or Differential Control. Control point easily adjusted by set pointer.
- Fully adjustable, self-locking differential between high and low contacts. Safe contact voltage—never over 6 volts. Current in micro-amps.
- Self-wiping control contacts made of non-corrosive Monel. All other parts are hermetically sealed against corrosion.
- Electronic tube, Relay and R-C Can are plug-in units. Load Contacts on Relay are Single-pole double-throw.
- Attachments can be fitted to present 100 Series Taylor Instruments with no drilling.
- Internal wires and external connections numbered for easy servicing. Signal lights and vibration damping available.

**H**ERE'S rugged, positive contact action for control mechanisms of the two-position action type—the "on-offs", "open-shuts" and "high-lows". This new Taylor Electronic Contact Controller embodies a completely new concept in contact mechanisms—it's designed for:

1. Accurate and dependable operation of electrical circuits.
  2. On-off applications with small process lags, slow reaction rates, and small and infrequent load changes.
  3. Use on nearly all types of measuring systems—temperature, pressure, liquid level, flow, humidity, speed, etc.
  4. Indicating, recording and/or controlling purposes.
- An extremely versatile instrument, the new Taylor Electronic Contact Controller can be used in many different places where pneumatic facilities aren't advisable or available. It's made also for use as a supplement to pneumatic control.

These standard forms emphasize the flexibility of the instrument: Two-Position Single Point Action (On-Off), Two Position Differential-Gap Action (On-Off with adjustable differential gap or neutral zone), and Three-Position Differential Gap Action (High-Medium-Low, differential adjustable).

For full details ask your Taylor Field Engineer or write for **Bulletin 98265**. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

*Taylor Instruments*

— MEAN —

**ACCURACY FIRST**

IN HOME AND INDUSTRY



LOOK FOR THE  
JENKINS DIAMOND

PROTECT  
YOUR VALVE INVESTMENT  
Specify — and be sure you get  
**JENKINS**  
Renewable Composition  
**DISCS**

**MADE BY THE ORIGINATORS  
OF RENEWABLE DISC VALVES**

Jenkins Bros. has remained the leader in composition disc development and production since 1864, when the first renewable disc valve was introduced.

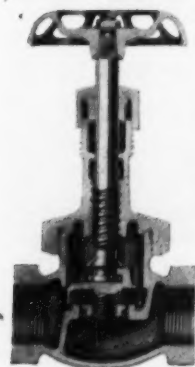
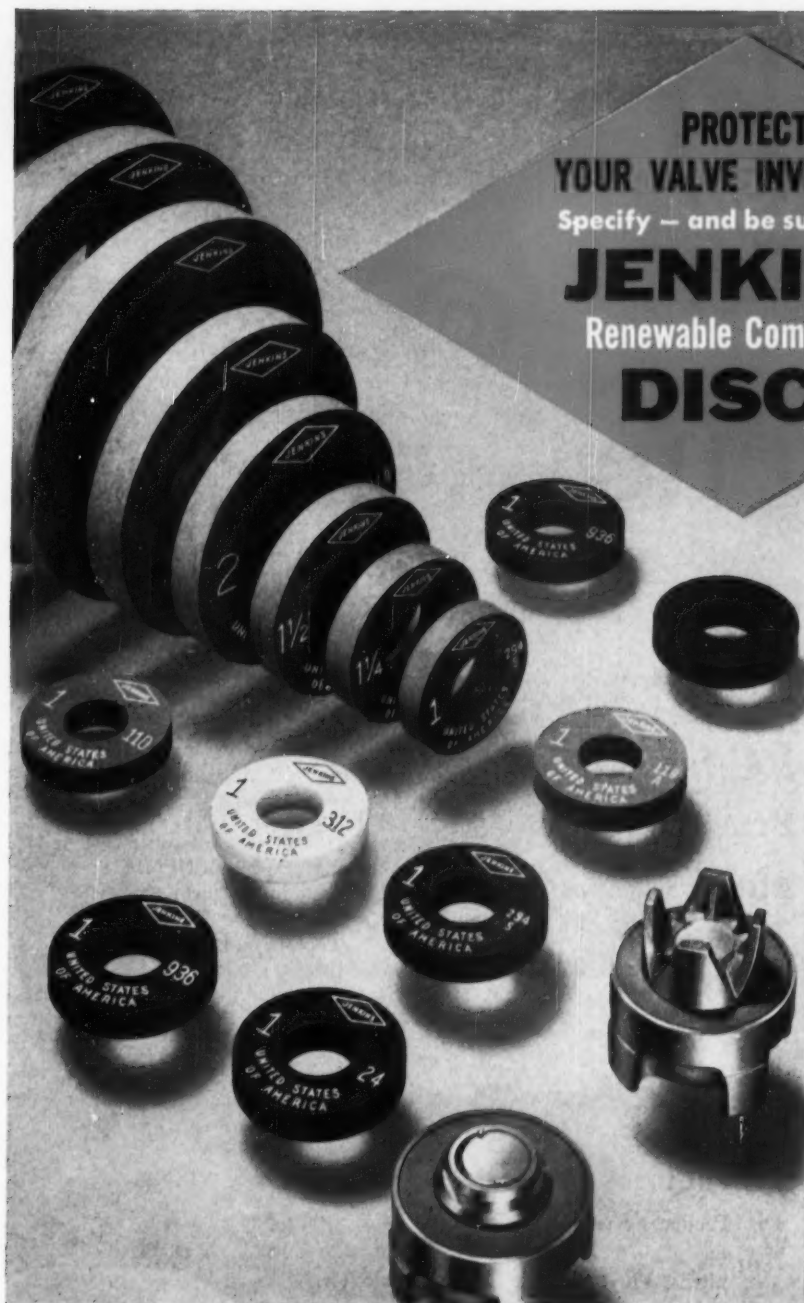
**THE ONLY MANUFACTURER OF  
BOTH VALVES AND DISCS**

Jenkins Bros. devotes continuous laboratory and field research to disc improvement through use of new compounds, and new production techniques.

**NEW GUIDE FOR  
DISC SELECTION**

Describes all Jenkins Discs, and their applications for steam, hot and cold water, air, gas, oil, gasoline . . . including the new **TEFLON® DISC** for lasting, dependable control of oxygen and other gases, solvents, acids, alkalies, and other chemicals,—and for liquid food and similar services.

Ask your Jenkins Valve Distributor for Disc Folder Form 203, or write: Jenkins Bros., 100 Park Ave., New York 17.



... for highest efficiency, use the  
time-proved combination ... **JENKINS DISCS** in

**JENKINS VALVES**



Order from Your Local Jenkins Distributor





# World's Largest Acetylene Plant

*from Natural Gas*  
(BASF Acetylene Process)

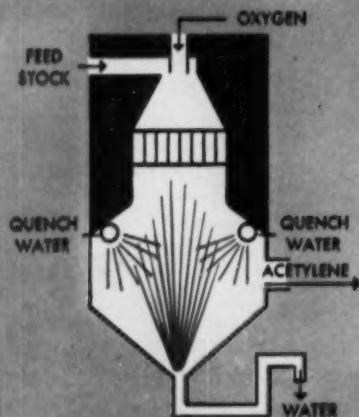
ENGINEERED AND BUILT BY  
**CHEMICO**

The BASF\* Acetylene Plant of American Cyanamid Company at Avondale, Louisiana, engineered and built by CHEMICO, is now being increased in capacity, making it the **WORLD'S LARGEST ACETYLENE PLANT OF ITS TYPE.**

By 1957, all the plants engineered and built by CHEMICO for the production of acetylene from natural gas will have a total capacity of 150,000,000 pounds per year.

Important features of the BASF process are listed below, and reprints of article describing this process are available upon request.

\* Badische Anilin & Soda Fabrik, AG, West Germany, holder of the basic acetylene process for which CHEMICO has exclusive rights in all North American Countries.



## Features of the BASF Acetylene Process

Produces commercially pure acetylene, meeting specifications for the manufacture of acetylene derivative products such as Acrylonitrile, Vinyl Chloride, Methylstyrene, etc.

Permits the use of a variety of feed stocks such as Methane, Ethane, Propane and other petroleum gases.

Produces off-gas suitable for Ammonia and Methanol synthesis.

Permits integrated production of Acetylene and Ammonia to meet changing market demand.

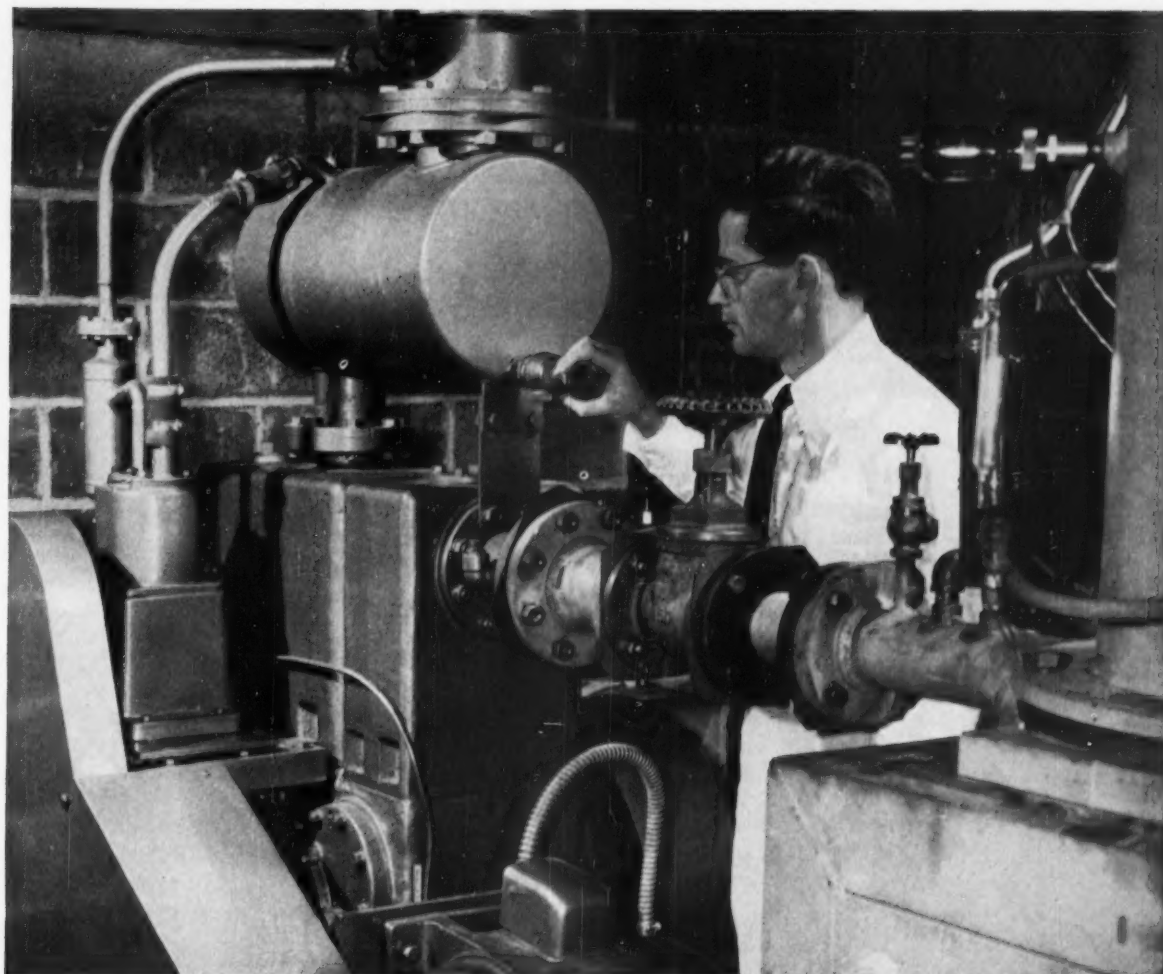
**CHEMICAL CONSTRUCTION CORPORATION**

A SUBSIDIARY OF ELECTRIC BOND AND SHARE COMPANY

525 WEST 43RD STREET, NEW YORK 36, NEW YORK







This is the NRC Rotary Gas Ballast Combination Pump Model NRC 200M. Other single and compound units with capacities from 1 1/4 to 400 CFM; blank-offs down to  $5 \times 10^{-6}$  mm. Hg.

## Here's the Only Vacuum Pump Proved to Pump Water Vapor, too!

On just one humid day a mechanical vacuum pump may be asked to digest moisture-laden air containing over two gallons of water. If this or any other vapor is allowed to condense in the pump oil, pump down cycles become longer and longer and longer — a real production "headache". An oil change, a costly and time consuming operation, is required to restore pump efficiency.

Only NRC Rotary Gas Ballast Pumps have proved — on thousands of installations — that they keep their original high efficiency even when pumping troublesome vapors.

Here is the reason: only NRC pumps have been designed around the gas ballast principle, which, with other design features, prevents condensation . . . keeps oil clean . . . maintains original fast pump down time day after day. Send for Bulletin.

**We Need  
FIVE ENTHUSIASTIC  
ENGINEERS  
To Help Us Keep Growing.**

Mechanical, electrical and chemical engineers who honestly enjoy solving novel problems in brand new fields are offered new responsibilities and more stimulating work. Write Mr. David Tobin or call De 2-5800.



**NRC**  
EQUIPMENT  
CORPORATION

### NRC EQUIPMENT CORPORATION

*A Subsidiary of*

### NATIONAL RESEARCH CORPORATION

Dept. 512, Charlemont St., Newton Highlands 61, Mass.

Please send me the NRC Rotary Gas Ballast Pump Bulletin.

Name.....Title.....

Company.....

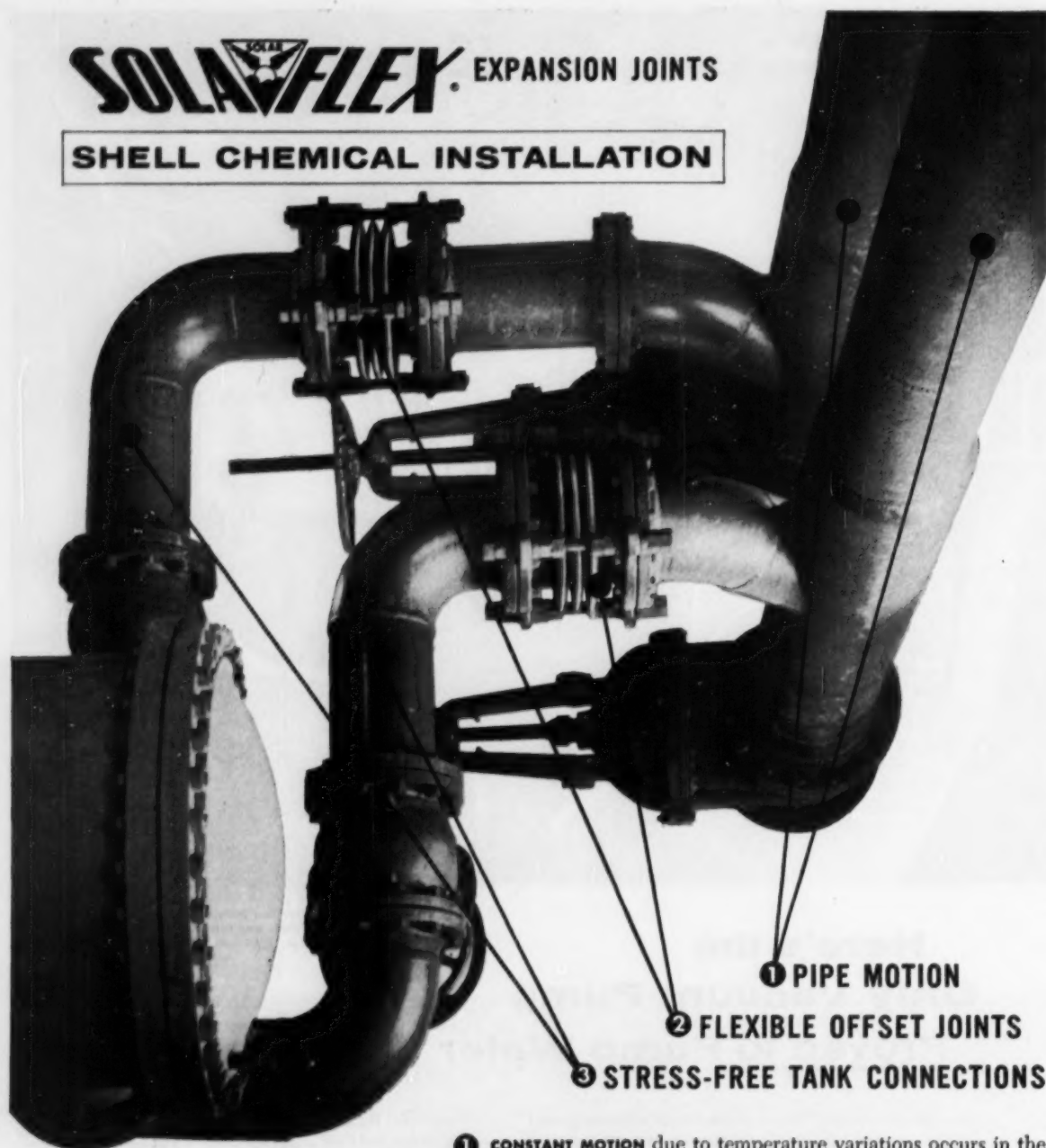
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City.....Zone.....State.....



# **SOLA FLEX** EXPANSION JOINTS

## **SHELL CHEMICAL INSTALLATION**



① PIPE MOTION

② FLEXIBLE OFFSET JOINTS

③ STRESS-FREE TANK CONNECTIONS

**SOLAR**  
AIRCRAFT COMPANY



- ① **CONSTANT MOTION** due to temperature variations occurs in the pipe lines for water cooling a Freon refrigeration unit at Shell Chemical in Torrance, California.
- ② Three-span Sola-Flex bellows take the lateral movement of the main piping system in offset. Tie bars prevent end thrust normally caused by the internal pressure.
- ③ With all stresses safely absorbed by Sola-Flex joints, pipe connections to the cooling tank are in balance and trouble-free service life is assured for all elements of the piping system.

Sola-Flex bellows have many uses in chemical installations. They are custom-engineered in any size, shape or configuration required. Stock items in all standard pipe sizes are also available. Send for a catalog of rugged, economical Sola-Flex joints. Dept. C-98, Solar Aircraft Co., San Diego 12, Calif.

Designers, Developers and Manufacturers • Gas Turbines • Aircraft and Missile Components • Bellows • Controls • Coatings • Metal Alloy Products



# How important is **CARBON DISULFIDE** (Carbon Bisulfide) to your operation?

***Baker, pioneer of the electrothermic method, assures you CS<sub>2</sub> of highest purity and uniformity—at low cost.***

## **SPECIFICATIONS FOR Baker CARBON DISULFIDE, TECHNICAL**

Boiling Range \_\_\_\_\_ 0.5° C.\*  
Specific Gravity at 15°/15° C. \_\_\_\_\_ 1.270-1.275  
Residue after Evaporation \_\_\_\_\_ 0.001% Max.  
Foreign Sulfides & Dissolved Sulfur Passes Test\*\*  
Sulfite and Sulfate (as SO<sub>2</sub>) \_\_\_\_\_ Passes Test\*\*

\*Boiling Point of Pure CS<sub>2</sub> at 760 mm. = 46.3° C.  
\*\*A.C.S. test for the absence of these impurities in reagent carbon disulfide.

### **STANDARD CONTAINERS**

TANK CARS—8,000 gallon (83,000 lbs.),  
10,000 gallon (105,000 lbs.)  
SINGLE TRIP DRUMS—55 gallon, 10  
gallon, 5 gallon.

If you manufacture rayon or cellophane, rubber accelerators, carbon tetrachloride, flotation agents, insecticides—or any one of a wide variety of other products—you want Carbon Disulfide with *uniformity* and *purity* at *low cost*.


To assure all three of these essentials, Baker produces Carbon Disulfide by the unique electrothermic method, a process invented by Taylor, and improved and perfected by Baker.

This special method...coupled with continuous rather than batch distillation...insures uniformity in the finished product. You will find Baker Carbon Disulfide exceptionally free from other sulfur compounds.

No matter what product you manufacture—if it requires a superior Carbon Disulfide of controlled purity and uniformity at low cost—it will pay you to specify Baker.

Baker is one of the principal volume producers of Carbon Disulfide. Our production is continuous...our sales are made in Tank Car or Carload Lots to many of the large users. If you require Carbon Disulfide for your process, Baker solicits your business.

Address J. T. Baker Chemical Co., Executive Offices, Phillipsburg, N. J.

**J. T. Baker Chemical Co.**  
REAGENT •  • FINE • INDUSTRIAL  
**Phillipsburg, New Jersey**



it's NEW...  
it's WIDE...  
it's BRIGHT



**MicroRold<sup>®</sup>**  
**STAINLESS**  
**SHEET**

**Type 430 Bright Finish**

**up to 48" WIDE**



**BRIGHTER THAN EVER!**—MicroRold stainless steel Type 430 in the NEW Bright Finish is now immediately available in sheets up to 48" wide offering new usefulness and economy in stainless fabrication. Produced with the same micro-accuracy of gauge for which MicroRold 36" is well known, Type 430 Bright up to 48" wide gives greater latitude in applications for quality stainless steel.

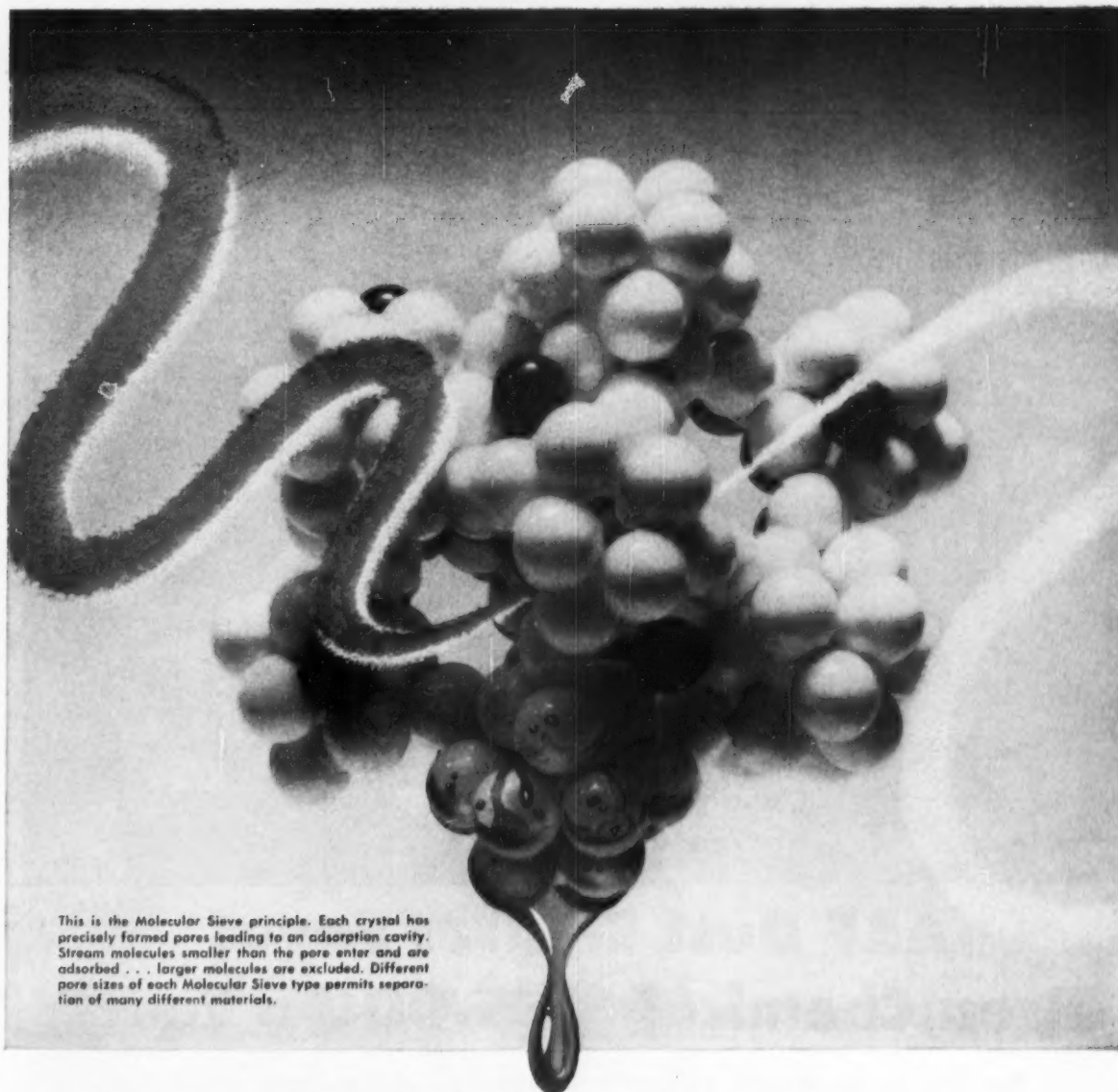
MicroRold 430 is also available in the regular commercial finishes and MicroRold stainless in other grades are now produced up to 48" wide. Complete details sent on request.

**Washington Steel**  
*Corporation*

WOODLAND AVENUE

WASHINGTON, PA.





This is the Molecular Sieve principle. Each crystal has precisely formed pores leading to an adsorption cavity. Stream molecules smaller than the pore enter and are adsorbed . . . larger molecules are excluded. Different pore sizes of each Molecular Sieve type permits separation of many different materials.

## Now...SELECTIVE Separation with MOLECULAR SIEVES

LINDE Molecular Sieves, a new class of adsorbents, offer unique performance in product purification and recovery. These synthetic crystalline zeolites provide selective separation of gaseous and liquid mixtures on three totally new bases . . . difference in molecular size . . . in polarity . . . in carbon bond saturation.

Selective removal of contaminants, even in trace amounts, is possible at temperatures up to 300° F. Selective recovery of valuable stock is often accomplished without regard to relative boiling points. Co-adsorption eliminates extra processing steps by removing several impurities simultaneously. High capacity is realized

through a wide range of operating conditions.

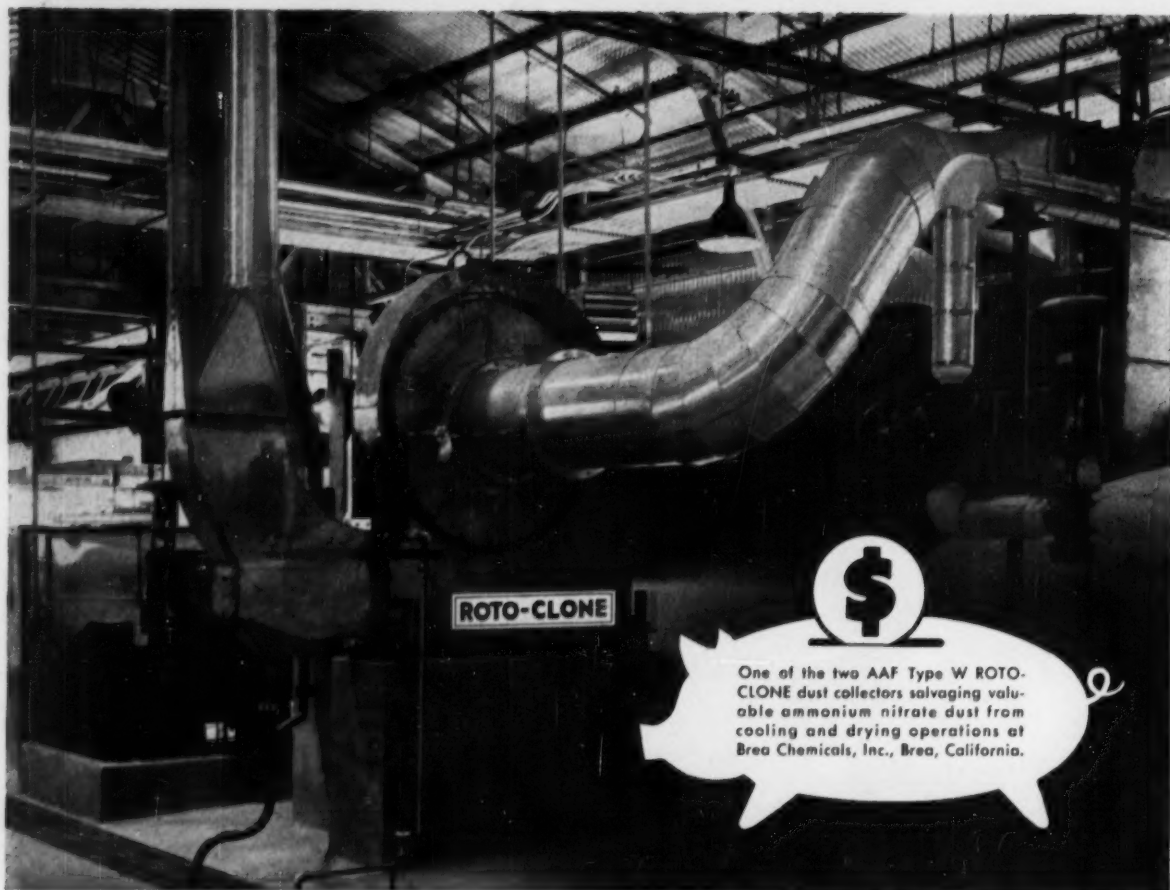
Typical production applications of Molecular Sieves are the separation of n-paraffins from iso-paraffins and cyclics . . . extraction of olefins from refinery streams and top gases . . . removal of catalyst poisons from olefins . . . sweetening of natural gas and reformed hydrogen . . . purification of annealing gases.

For a descriptive booklet, "Molecular Sieves for Selective Adsorption," write Dept. CG-12, Linde Air Products Company, A Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y.



The term "Linde" is a registered trade-mark of Union Carbide and Carbon Corporation





## AAF Dust Control Saves Brea Chemical \$135,000 a Year!

Brea Chemicals, Inc., demanded *two* benefits from dust control equipment exhausting cooling and drying operations. One was dust-free discharge stacks; the other was *salvage* of valuable ammonium nitrate dust. They selected wet-collecting Type W ROTO-CLONES for this double-barreled job.

Instead of water, they use liquid ammonium nitrate in the Type W's scrubbing sprays. This allows all collected dust to be returned to the process as a usable solution. Five tons (which

otherwise might have been a neighborhood nuisance) are salvaged every 24 hours — *an annual saving of \$135,000!*

That's an example of the job being done by the Type W ROTO-CLONE throughout industry. The efficiency of this versatile dust collector results from its unique design, which combines the scrubbing action of liquid sprays and the principle of dynamic precipitation. For complete information, call your local AAF representative or write direct for Bulletin 274.

**AAF** American Air Filter  
COMPANY, INC.

326 Central Avenue, Louisville 8, Kentucky  
American Air Filter of Canada, Ltd., Montreal, P. Q.

AAF Filters  
and Precipitators



Illinois  
Heating Specialties

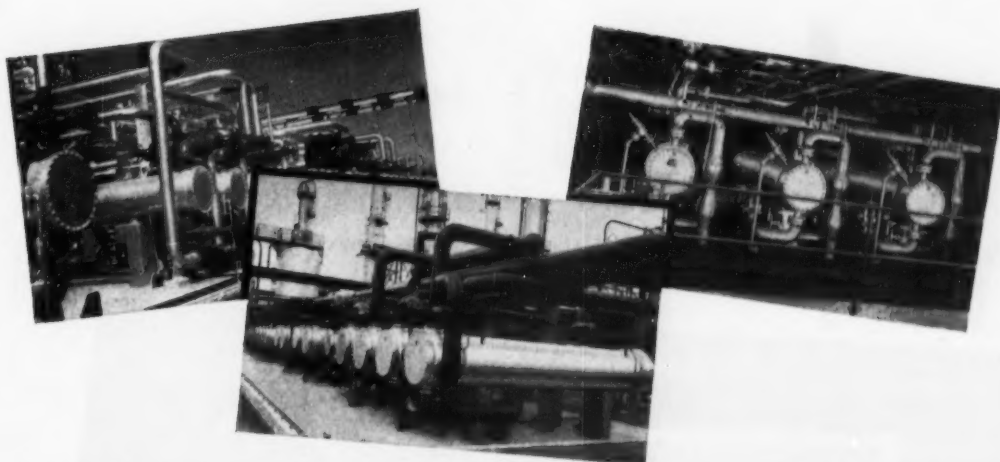
— BETTER AIR IS OUR BUSINESS —

AAF Dust  
Control Equipment



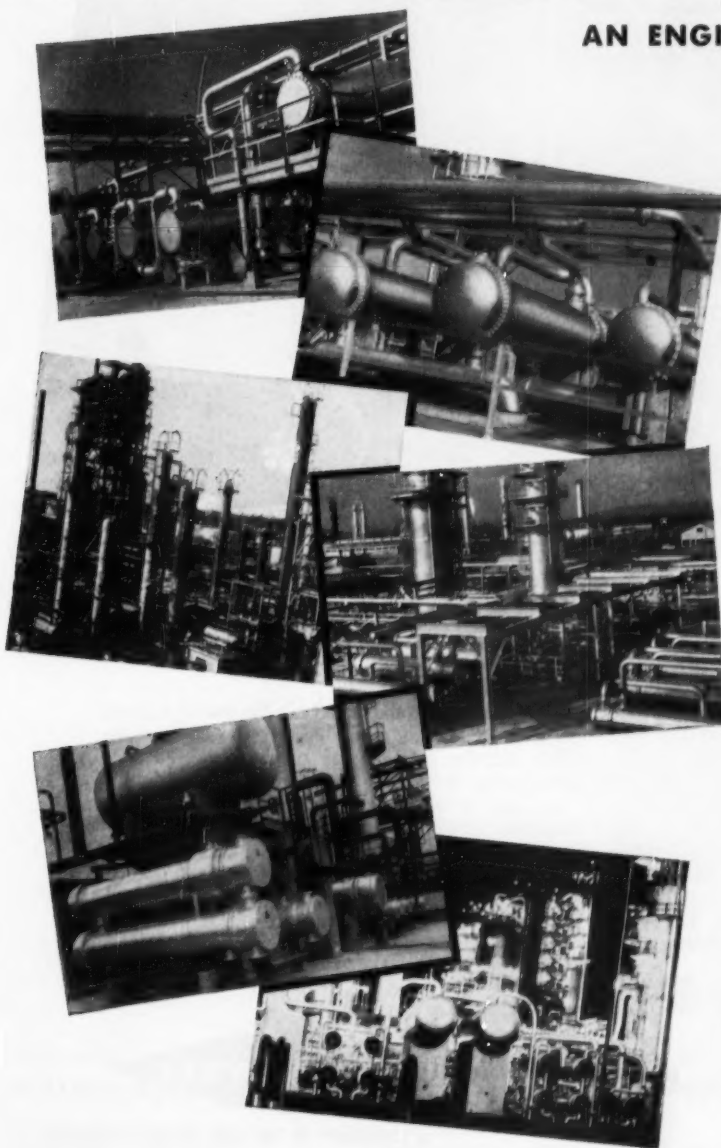
Herman Nelson  
Industrial Heaters





## what heat transfer characteristics are needed here...and why?

### AN ENGINEERED ANSWER FOR YOU



*In substance, and in nearly every instance, that's the question that's put to Ross.*

*It can apply to chemical processing, petroleum refining, power generation or nuclear energy... wherever specialized heat exchangers are indicated.*

*It may call for a highly complex design, high temperature or high pressure construction, special materials... a single unit or dozens of identical ones.*

*The point is that whatever the requirements, Ross will present you with a thoroughly considered, engineered answer. No one is more qualified to give it. No one is better equipped to deliver the finished product.*

*When you come to Ross for the engineering solution, of this you can be certain: your questions or those of your consultants will be answered with well qualified "reasons why," based upon vast experience in the specially engineered shell and tube heat exchanger field. Your inquiry will bring a nearby Ross representative promptly to your desk.*

*Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.*





*how would you like to add  
\$250,000.00 to your profit?*



***Dowell Chemical Cleaning Made  
This Possible for an Industrial Plant!***

In 1954 an East Coast plant employed Dowell Chemical Cleaning Service on a limited basis. The results were encouraging.

In 1955 the same company expanded its use of chemical cleaning. The results were startling. More throughput, less down time, and greater overall plant efficiency effected nearly a **\$250,000.00 saving!**

In 1956 the program was continued. The result: still more savings. Eventually, chemical cleaning on a continuing year-around basis is expected to effect savings of from \$300,000.00 to \$500,000.00 annually.

This case history is about an oil refinery. However, Dowell has eye-opening performance data to show you in almost any industry.

Dowell engineers are experts in the use of solvents to remove scales and sludges—those deposits that cut the capacity of process and steam generating systems. Dowell does the job for you and furnishes all necessary chemicals, trained personnel, pumping and control equipment.

For additional information, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

*clean it chemically*

**DOWELL**

A SUBSIDIARY OF THE DOW CHEMICAL COMPANY

December 1956—CHEMICAL ENGINEERING



# NUCOR *Straight-thru* magnaflow flow meters

## SOLVE DIFFICULT FLOW PROBLEMS!

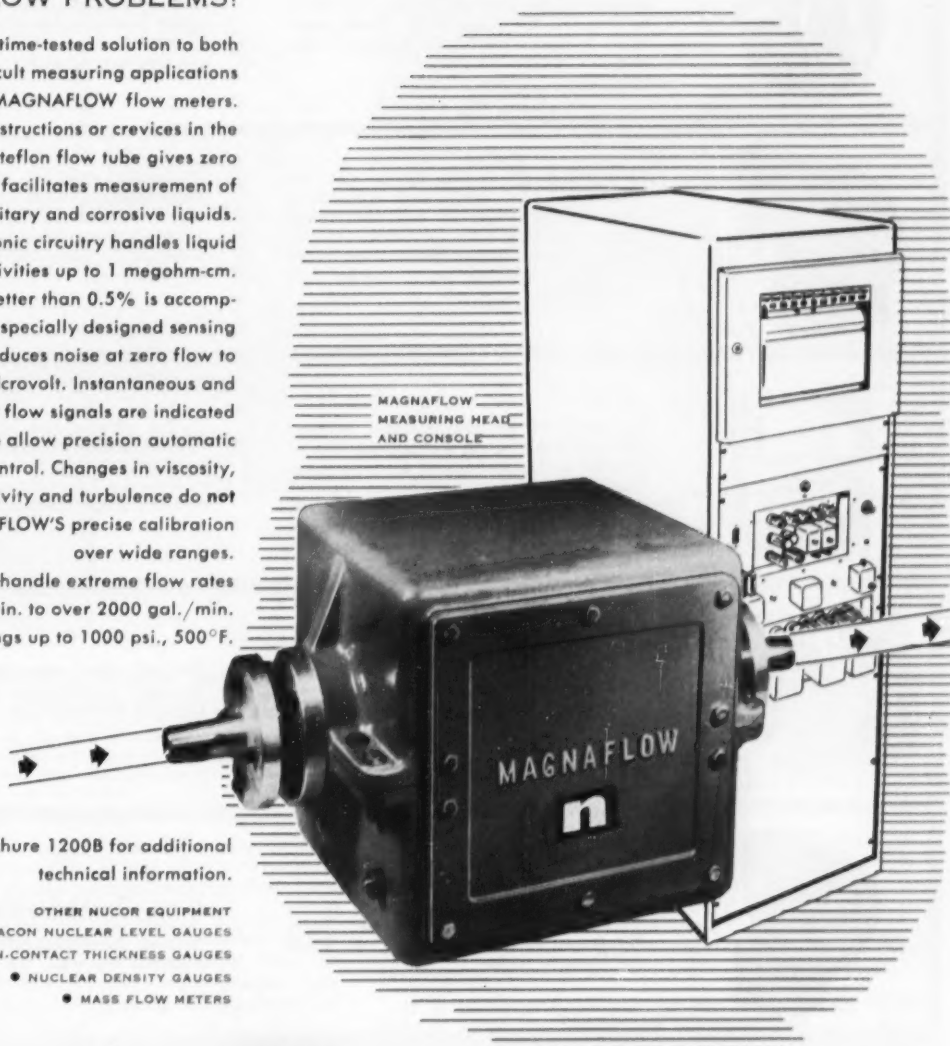
The practical time-tested solution to both standard and difficult measuring applications — NUCOR MAGNAFLOW flow meters.

Absence of obstructions or crevices in the smooth-bore teflon flow tube gives zero pressure drop — facilitates measurement of hard-to-handle sanitary and corrosive liquids.

Unique electronic circuitry handles liquid resistivities up to 1 megohm-cm.

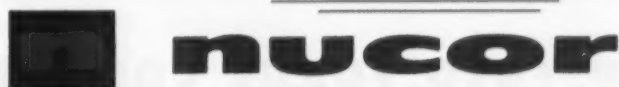
Accuracy of better than 0.5% is accomplished by use of a specially designed sensing head which reduces noise at zero flow to less than 1 microvolt. Instantaneous and completely linear flow signals are indicated and/or recorded to allow precision automatic production control. Changes in viscosity, density, conductivity and turbulence do not affect MAGNAFLOW'S precise calibration over wide ranges.

Standard units can handle extreme flow rates . . . 100 cc/min. to over 2000 gal./min. . . standard ratings up to 1000 psi., 500°F.



Write for Brochure 1200B for additional technical information.

- OTHER NUCOR EQUIPMENT
- INDACON NUCLEAR LEVEL GAUGES
  - ATOMAT NON-CONTACT THICKNESS GAUGES
  - NUCLEAR DENSITY GAUGES
  - MASS FLOW METERS



ADVANCED-DESIGNS FROM A GREAT NAME IN PROCESS CONTROL EQUIPMENT . . .  
**NUCLEAR CORPORATION OF AMERICA, INC.**

EMPIRE STATE BUILDING  
NEW YORK 1, NEW YORK

SALES OFFICES:  
NEW YORK CITY, DETROIT, ST. LOUIS, LOS ANGELES, CHICAGO, BOSTON, CLEVELAND, ATLANTA



# PICK THE RIGHT FAN NOW

## —and have no regrets later

### "BUFFALO" FAN

### APPLICATIONS

### CHARACTERISTICS



Type BL Fan

Supplying large ventilation, air conditioning and air cleaning systems. Type BL is used in Class I service, while Type BLH is designed for Class II-IV (high pressure) service. Write for BL Bulletin F-101 and BLH Bulletin F-200.

Extremely quiet and high in efficiency; stable performance from zero pressure to shutoff; non-overloading regardless of system pressure; available in capacities up to 500,000 cfm, all drive arrangements and discharge angles.



Type CR Fan

New "Buffalo" Radial Blade Fan for severe industrial services such as handling abrasive dust-laden air and economical mechanical draft. The CR's high capacity, high pressure characteristics often mean a smaller fan for the job. Write for Bulletin FD-205.

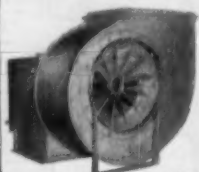
Mechanical efficiency above 78% over a broad range—high volume, high pressure characteristics, also high resistance to abrasion. Long life under severe conditions. An economical fan to own and operate.



Package Propeller Fans

For wall or window-mounted ventilation and exhaust; capacities from 500 to 250,000 cfm. Available in non-sparking, high temperature and corrosion-resistant models, also package roof ventilators. Write for Bulletins FM 1234 and FM 2345.

Husky, die-stamped blades and frame. Proven unusually high in efficiency in hundreds of installations. Compact, easy to install packages for economical ventilation of a single room or a whole building.



Belted Vent Sets

For zone ventilation where quiet and flexibility are required. Capacities from 1000 to 20,000 cfm. Write for Bulletin 3720.

Efficient, quiet, non-overloading. Simple package installation, indoors or out. Capacity adjustable by changing sheaves.



Industrial Exhausters

Moving materials or exhausting fumes, mists, dust; available with heat slinger for temperatures up to 1000° F. Write for Bulletin 3576.

Heavy all-welded steel plate for strength, smooth interior surfaces for minimum friction. Interchangeable Air Wheels or Material Wheels.

## BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



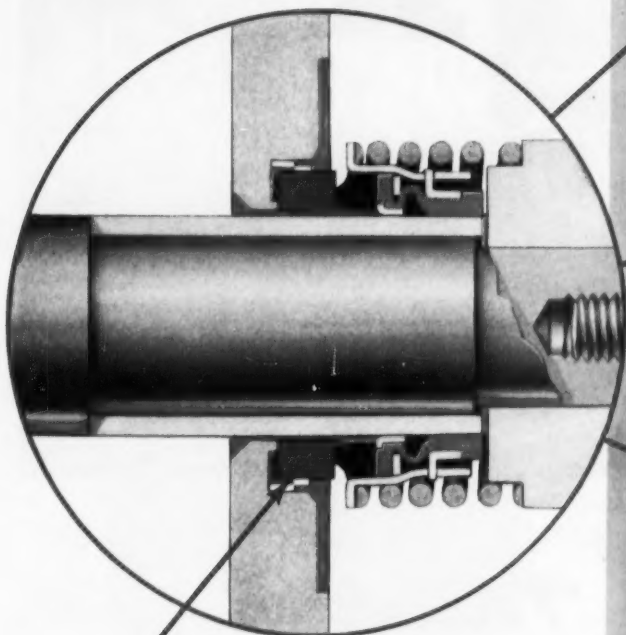
VENTILATING   AIR CLEANING   AIR TEMPERING   INDUCED DRAFT   EXHAUSTING   FORCED DRAFT   COOLING   HEATING   PRESSURE BLOWING



A great line of pumps  
all equipped with the

# B & G

## TROUBLE-PROOF SEAL ASSEMBLY



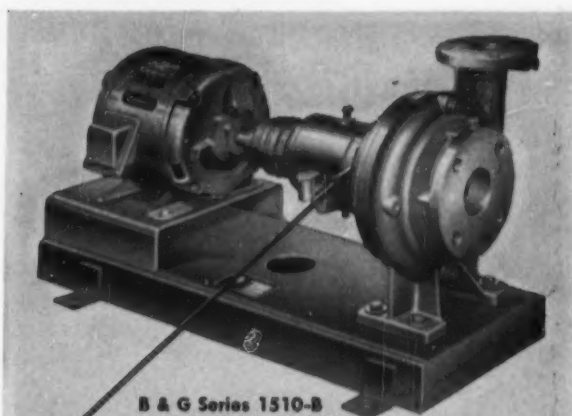
### Leak-Proof "Remite" Mechanical Seal

This exclusive B & G feature eliminates the customary leakage which occurs where a packing gland is used. A Carbon Seal Ring faces on a "Remite" floating seat—a new type of material, so hard it will scratch glass—wear-proof and corrosion-resistant. Metal parts are of steel, bronze or stainless steel, depending upon the type of service. The B & G Mechanical Seal is self-lubricating.

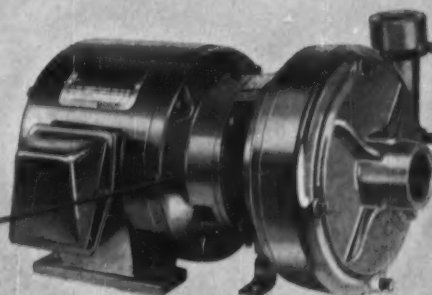
Take just a moment to examine the design features of B & G Centrifugal Pumps. You'll find plenty of reasons why these pumps are giving trouble-proof performance through long years of service.

*Vertical split-case construction* permits removal of the bearing bracket without disconnecting pipe lines or motor leads. Solid cast iron volutes—with support feet in the larger units—effectively prevent transmission of piping strains to the motor.

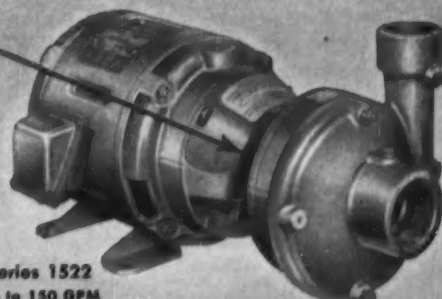
The shafts of B & G Centrifugal Pumps are an outstanding feature. Made of special alloy steel, they are



**B & G Series 1510-B**  
Capacities to 1100 GPM,  
heads to 420 ft.



**B & G Series 1531-B**  
Capacities to 1500 GPM,  
heads to 420 ft.



**B & G Series 1522**  
Capacities to 150 GPM  
heads to 115 ft.

super-finished and oversized to keep deflection at a minimum. The "Remite" Mechanical Seal—a B & G development—positively prevents leakage...and impellers are soundly designed to maintain hydraulic balance. An oil lubrication system, instead of grease cups, assures continuous protection to the long bronze bearings of these pumps.

B & G Centrifugal Pumps are available as all-iron, bronze-fitted, all-bronze and stainless steel units and in capacities which adapt them to a wide range of industrial applications.

Send for complete data on these  
three outstanding centrifugal pumps



## BELL & GOSSETT

### C O M P A N Y

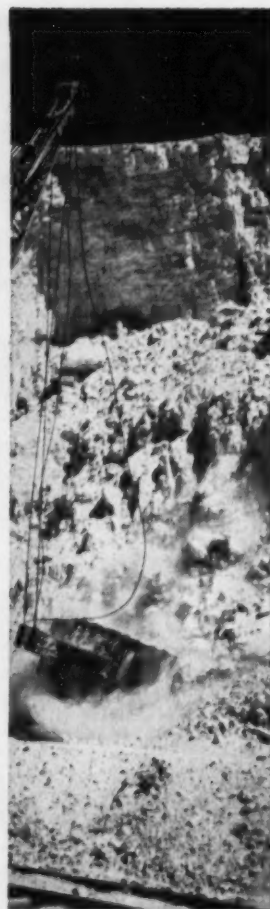
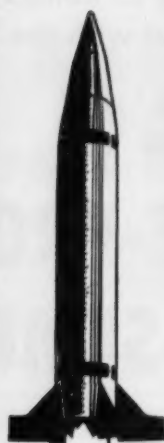
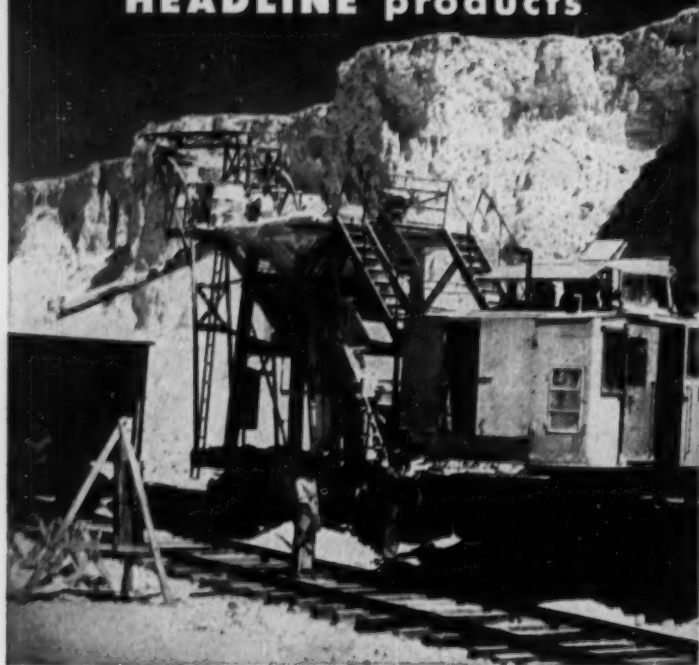
Dept. EP-14, Morton Grove, Illinois

Canadian License: S. A. Armstrong, Ltd., 1400 O'Connor Drive, W. Toronto



# SULPHUR

helps to create  
**HEADLINE** products



"Thiokol" synthetic rubber, is an organic polysulfide elastomer. One of its many uses is in solid propellents for long range and high altitude missiles. In liquid form, "Thiokol" synthetic rubber mixed with an oxidizer, is poured into specially designed combustion chambers of rockets. It helps to give stability to the fuel charge and resistance to shock. It promotes uniform burning. When the rocket motor is ignited the mixture burns with great intensity and generates large volumes of gas to propel the rocket.

Solid propellents made with "Thiokol" synthetic rubber have

proved their value in rockets over liquid propellents in many ways: they are less costly and easier to manufacture—simple and rugged construction makes handling and launching easier and safer—fuel tanks and complicated feed systems are eliminated.

"Thiokol" synthetic rubber is a product containing a high percentage of Sulphur—its name being derived from the Greek words for sulphur and glue. Here is another example of the continually broadening field in which Sulphur is an important and necessary element.

*\*A trade name of Thiokol Chemical Corporation.*



## Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.  
811 Rusk Avenue, Houston 2, Texas

Sulphur Producing Units

- Newgulf, Texas
- Spindletop, Texas
- Moss Bluff, Texas
- Worland, Wyoming



Look  
for this  
honored



# Name Plate . . . a guide to advanced designs

in package unit and custom built  
steam generating equipment



Vogt steam generating units are available in types and sizes to meet individual plant needs for power, processing or heating.

Package units range from 10,000 to 40,000 pounds of steam per hour while custom built units are obtainable in the larger capacities. Available in bent tube types and straight tube, forged steel sectional header types for solid, liquid or gaseous fuels burned singly or in combination.

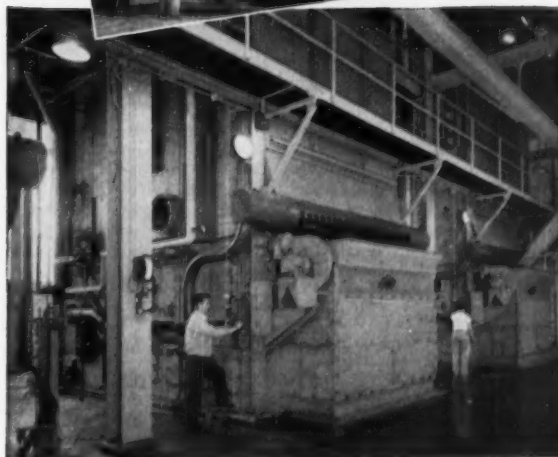
Write for Bulletins, Dept. 24A-BC

**HENRY VOGT MACHINE CO.**

Box 1918, Louisville 1, Kentucky

#### SALES OFFICES

New York, Chicago, Cleveland, Dallas, Philadelphia  
St. Louis, Charleston, W. Va., Cincinnati, San Francisco



One of three 15,000 #/hr. capacity package unit steam generators for a State institution.

Two of three 41,000 #/hr. steam generators installed in Medical Center Steam Plant, Louisville, Ky.

Erecting two 50,000 #/hr. steam generators at Kelly Air Force Base, San Antonio, Texas.



OTHER VOGT PRODUCTS



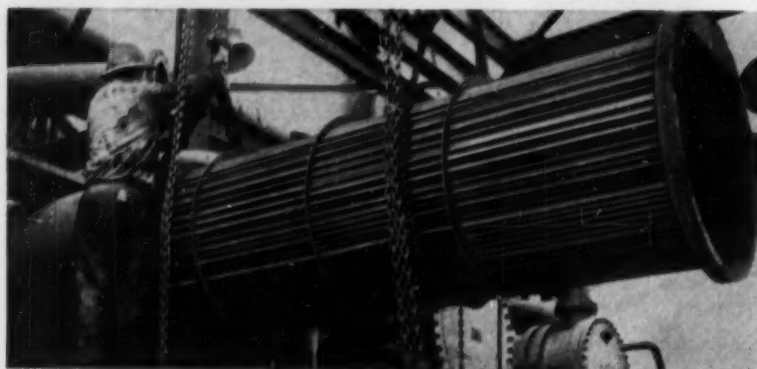
# BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

## COPPER ALLOY BULLETIN



MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Replacing a copper alloy tube bundle after cleaning.

### How to Reduce Exchanger Maintenance Costs by Using Performance Records

Although tube and shell heat exchangers fall into well-defined classes of design and operation, the variables in each exchanger situation make it an "individual" in respect to performance or corrosion failure. For this reason, comprehensive and continuing performance records on each exchanger are essential in achieving maximum operating efficiency and productivity.

#### Why Keep Records?

The primary purpose is to establish a performance pattern which will suggest a minimum though adequate maintenance schedule. Proper records should also help to detect variations in operating conditions which, though slight, may require significant changes in maintenance scheduling.

#### Tube Selection Important

Such performance records can also help determine whether or not the best exchanger design or tube alloy is being used. For example, although Bridgeport Arsenical Admiralty or Arsenical Muntz would ordinarily be indicated for saline or brackish cooling water, adequate records will often reveal that Bridgeport Duplex, Copper, Red Brass, Arsenical Aluminum Brass, Duralumin IV or occasionally 70-30 Cupro Nickel would be more economical.

#### Preplanning and Scheduling

Another benefit in adequate record-keeping is in the preplanning of maintenance repairs. The nature and extent of the maintenance can be known and prepared for previous to shutdown, per-

mitting servicing with minimum loss to operating time. Likewise, sufficient lead time can be allowed in ordering tube replacements or in obtaining qualified technical help in determining the proper tube alloy to use if this is indicated.

#### Watch Those "Variables"

A file of records does not in itself constitute a maintenance program. Instead, critical evaluation must be made of each report so that existing maintenance schedules may be confirmed or altered. A particularly keen eye should be kept on those variables not normally recorded by the operating staff. Minor changes in water composition or product streams

may not be important in production, but may significantly affect fouling or corrosion rates. For instance, in petroleum refining and petrochemical processing, the hydrocarbons have virtually no effect on copper and its alloys. But the presence of sulfides, chlorides, acids, ammonia, gases and moisture influenced by variations in temperatures, velocity and pressure will have an important effect on corrosion. Thus, where conditions such as these are detected, and where operational adjustments are not feasible, consideration should be given to the use of the other copper-base alloys or Duplex tubing.

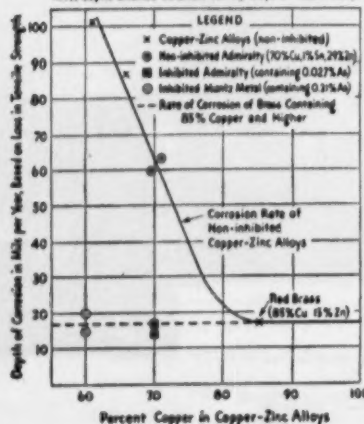
#### Records Help Lick Dual Corrosion

Another advantage of adequate record-keeping is in high-lighting the need for maintenance-reducing techniques. For example, under some conditions, the use of higher grade components, such as Duplex tubes, proves economical when yearly costs are totaled up. The experience of one refinery demonstrates this point. In an exchange between ammonia and hydrogen sulfide bearing propane gas and river water, the continual failure of steel and red brass tubes made it necessary to retube the exchangers every one or two years. A change-over to Bridgeport Duplex Tubes—with low carbon steel on the product side and red brass on the water side—resulted in an average life of from 6 to 10 years.

#### Technical Service

These are just a few of the advantages of keeping maintenance records on performance and how they can provide a clue toward solving your corrosion problems. For more specific help, the advice and experience of Bridgeport's Technical Service and Corrosion Laboratories are at your service through your nearest Bridgeport Sales Office. This service, plus Bridgeport's extensive selection of tubes and alloys, will enable you to meet your needs faster, easier and more economically. (842)

CORROSION RATE OF INHIBITED AND NON-INHIBITED COPPER-ZINC ALLOYS in 1% Cupric Chloride Solution for 78 Days at Room Temp.



### Further Help From Bridgeport's Condenser Tube Handbook

A wealth of practical detailed information on tube condensers and heat exchangers is contained in the Bridgeport *Condenser Tube Handbook*. Anyone concerned with the specifications, operation or maintenance of such units will find it an invaluable addition to his reference library. Write for your free copy.



# WILLIAMS ROLLER MILLS

• **Quality Fine Grinding...**  
**20 Mesh To 400 Mesh...**  
**Micron Sizes On Some**  
**Materials**

## EXCLUSIVE GEARLESS AND SPUR GEAR DRIVES

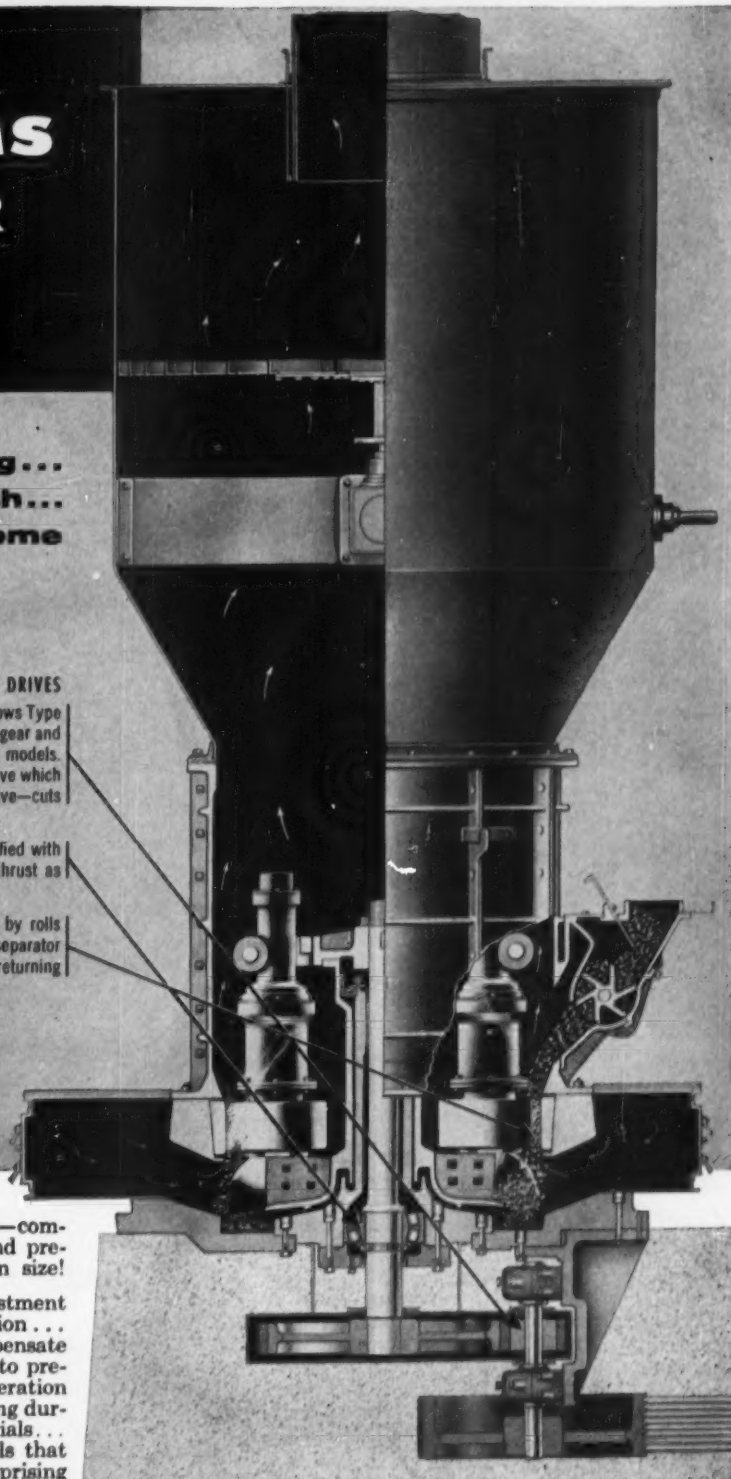
Another Williams advancement! Cutaway shows Type D Mill with Spinner Air Separator with spur gear and pinion drive used on Standard and larger models. Smaller sizes have simple gearless V-belt drive which is easier to maintain than bevel gear drive—cuts labor and downtime.

Bearing alignment of central shaft is simplified with only 2 bearings, the bottom one carrying thrust as well as radial load.

NOTE FLOW OF MATERIAL being ground by rolls rotating against bull ring, then air-swept to separator which discharges finished product while returning coarse tailings for regrinding.

From raw material to finished product—completely automatic grinding, blending and precision classifying to 20 mesh or micron size!

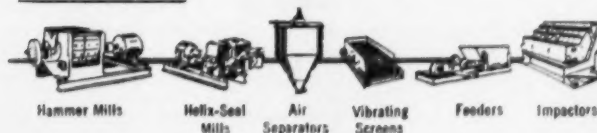
Self-adjusting feed rate... instant adjustment for sizing, even while mill is in motion... continuous automatic take-up to compensate for wear... constant rising air current to prevent build-up of fines and inefficient operation... automatically controlled hot-air drying during grinding of moisture-carrying materials... all are features of Williams Roller Mills that virtually guarantee increased output, surprising cost reductions and exceptionally high uniform quality. Get all the facts immediately... Write today for catalog.



WILLIAMS PATENT CRUSHER & PULVERIZER CO.

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**WILLIAMS**  
CRUSHERS GRINDERS PULVERIZERS  
Oldest and Largest Manufacturers of Hammer Mills in the World

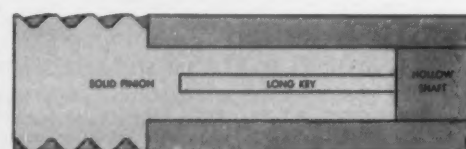


# In your opinion, which pinion?

... for longest life in a gearmotor



ORDINARY SHELL TYPE PINION



U. S. SOLID TYPE PINION

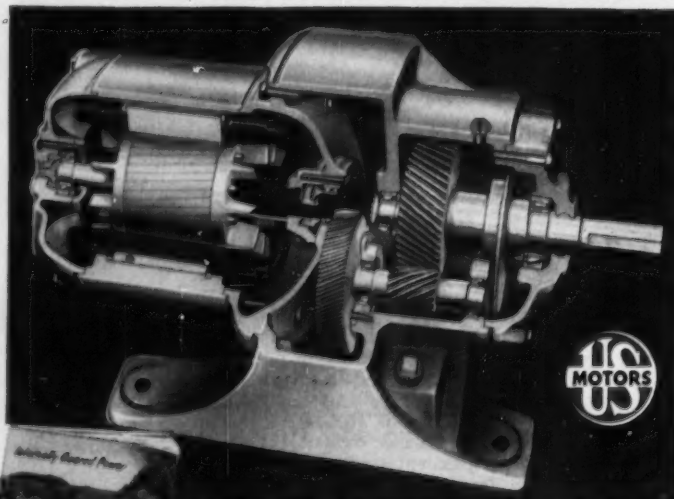
In an internally geared motor the pinion on the motor shaft is the vital link between motor and gearing. It's the fastest, but smallest gear, so it must be extra strong, free from vibration and forever tight. Now compare the U. S. Syncro-gear motor pinion with the ordinary type. Note the extra large section area of the U. S. design. It has a long solid shank that anchors into the motor's hollow shaft, whereas the ordinary shell type has a small section area, short keyed.

Obviously the U. S. design is most substantial, longer lasting, more resistant to deflection and can carry high speed loads far more safely than common designs. All the gears are deep-hardened and shaved to exact tolerances in the U. S. plants.

## Added life lengthening features

The rugged pyramidal case supports the motor and gear train and all castings are normalized to insure permanent alignment and to prevent distortion. The motor windings are asbestos-protected to avoid carbonization and guard against burnouts. All moving parts are completely enclosed for weather and dust protection and confined within the least cubical dimensions on a single mounting. 1/4 to 30 h.p.; 10 to 10,000 r.p.m.

## THE ONLY MOTOR WITH A BUILT-IN PINION U. S. SYNCROGEAR



U. S. Electrical Motors Inc. U.S.-18  
Box 2058, Los Angeles 54, Calif. or Millard, Conn.

NAME \_\_\_\_\_  
COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_



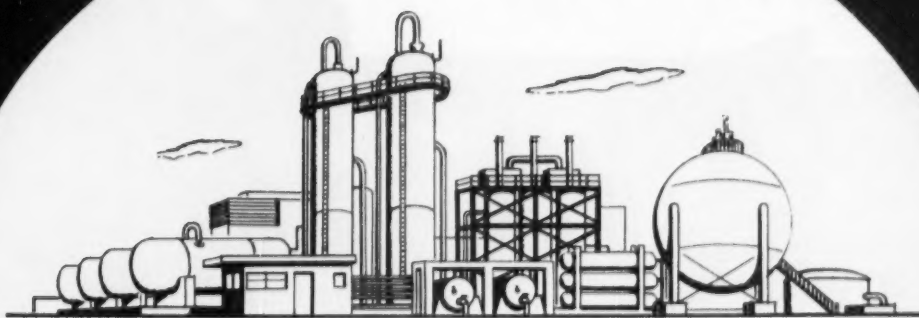
**FREE 16-PAGE DESCRIPTIVE BOOKLET GIVES ALL THE FACTS**  
Interesting multi-colored Booklet presents engineering facts you should know about geared motors, and illustrates the various U. S. Syncrogear types. Mail the Coupon for a copy. No obligation.

**U. S. ELECTRICAL MOTORS Inc.**  
Los Angeles 54, Calif. Millard, Conn.



*advances in the Chemical Industry  
through*

progress *with* Proctor



YOU CAN SHARE IN THIS PROGRESS

**PROFIT by PROCTOR's** careful analysis of your drying problem—actual test runs establish the optimum drying conditions for highest quality and product uniformity.

**PROFIT by PROCTOR's** five decades in the creation and design of drying systems—by the low operating cost resulting from Proctor's ability to accurately convert test results into full scale performance.

**PROFIT by PROCTOR's** up-to-the-minute shop and manufacturing techniques—by the ruggedness and dependability built into every Proctor product, giving true value for every dollar.

**PROFIT by PROCTOR's** record of progress over the years—a record of the satisfaction and confidence of the many Proctor customers.

**PROFIT by PROCTOR's** policy of GUARANTEED performance.

1900	TRAY TRUCK DRYERS
1923	JOB-ENGINEERED CONTINUOUS CONVEYOR DRYERS
1923	CHEMICAL LOOP DRYERS
1934	FIN DRUM FEED
1937	GRANULATOR
1938	ROLLING EXTRUDER
1938	SCORING ON FILTER
1953	SPRAY DRYERS

**PROCTOR & SCHWARTZ, Inc.**

PHILADELPHIA 20, PA.

*Manufacturers of Industrial Drying Equipment and Textile Machinery*



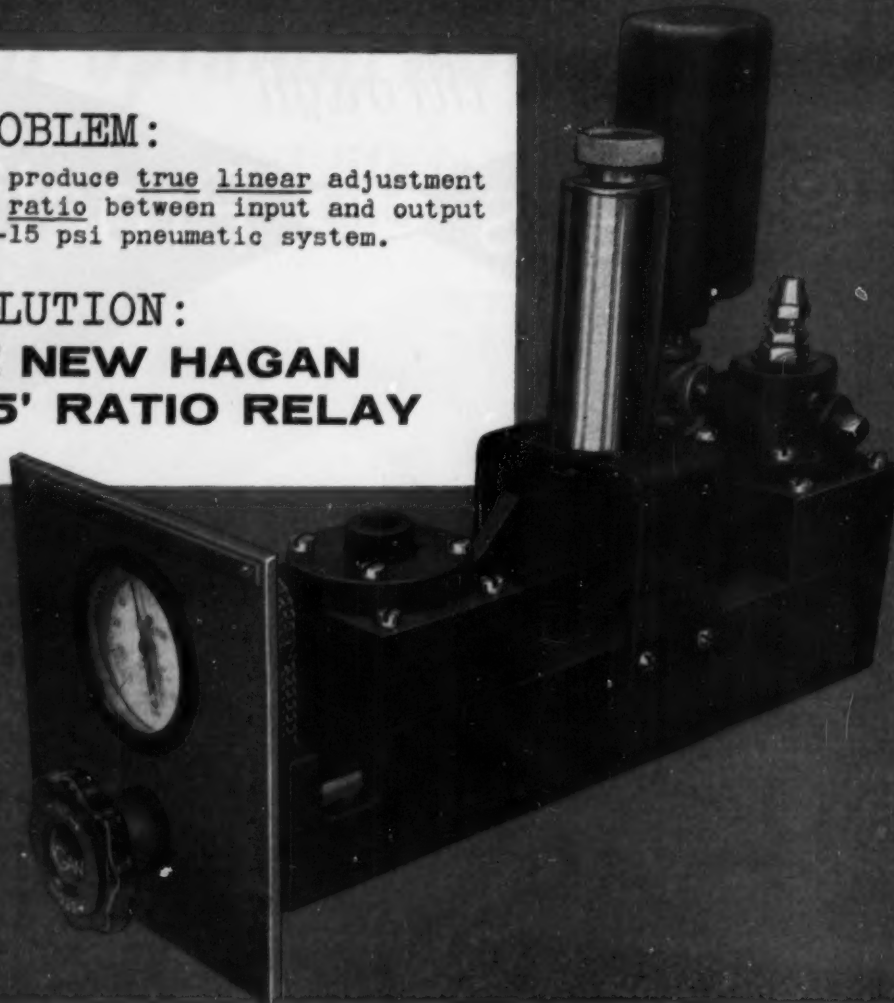


## PROBLEM:

how to produce true linear adjustment of the ratio between input and output in a 3-15 psi pneumatic system.

## SOLUTION:

### THE NEW HAGAN '3-15' RATIO RELAY



This unique Hagan device fills a long felt need in pneumatic process control systems for a relay which will permit the operator to adjust the ratio between input and output signals.

Rugged and reliable, and requiring small space, the Hagan Model '3-15' Ratio Relay produces a true linear proportional change in the output signal. Designed primarily for use with 3-15 psig signals, the '3-15' is easily adjusted to change the minimum input and output bias values to any point between zero and six psig. The actual maximum input and output signals may be any value up to 20 psig.

The Hagan '3-15' is ideally suited for any process control systems such as fuel to air ratio in combustion processes, ratio of gases in gas mixing or in the proportional feeding of chemicals. See your Hagan engineer, or write for full details. Ask for Specification Sheet SP4315.

#### HAGAN MODEL '3-15' RATIO RELAY

True ratioing around 3 psig input  
Compatible with any signal system whose range is between 0 and 20 psig  
Simple means for altering suppressed scale setting, if desired  
Mounting Plate dimensions— $6\frac{1}{2}'' \times 6\frac{3}{4}''$   
Input range—0-20 psig  
Output range—0-20 psig  
Minimum Ratio setting—0.3 to 1  
Maximum Ratio setting—3.75 to 1  
Suppressed Scale Range (adjustable)—0-6 psig

## HAGAN CORPORATION

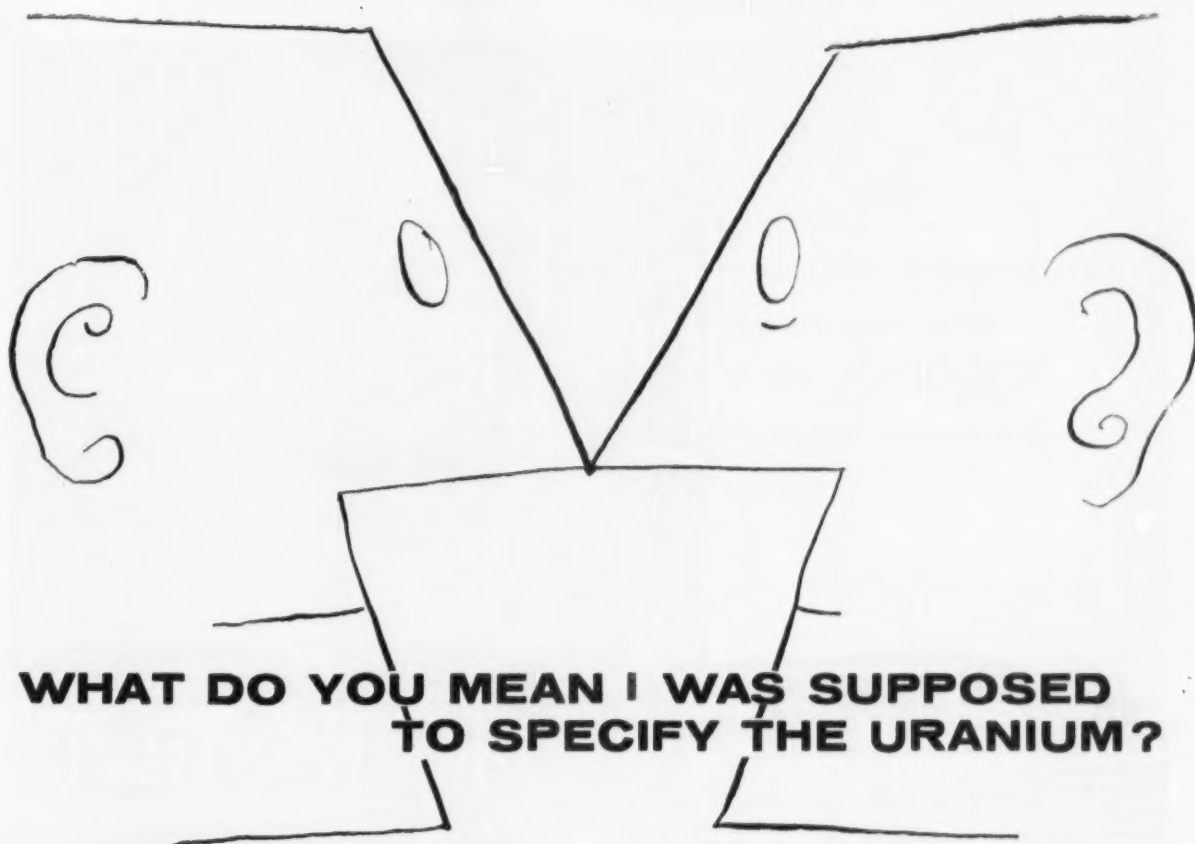
HAGAN BUILDING, PITTSBURGH 30, PA.



Systems and Components for: Process Control, Metallurgical Furnace Control, Boiler Combustion Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemicals for Water Conditioning

HAGAN SUBSIDIARIES: CALGON, INC. • HALL LABORATORIES, INC.





## WHAT DO YOU MEAN I WAS SUPPOSED TO SPECIFY THE URANIUM?

THE CHEMICAL PROCESS INDUSTRIES is a sprawling giant of a market . . . but despite its size and many varied segments (chemical, drug, fertilizer, plastic, rubber, atomic, etc.) . . . all CPI operations must, and *do*, have . . . specific groups of men directly responsible for recommending, specifying and approving the chemicals, raw materials, equipment and services you have to sell.

Now, for the first time, to give the advertising and marketing executive an unbiased and accurately-defined picture of the relative importance of buying influences in the CPI...CHEMICAL ENGINEERING-CHEMICAL WEEK Research recently sponsored an exhaustive study actually conducted inside the plants of 29 leading industrial consumers (Monsanto, Union Carbide and Carbon, Victor Chemical, Wyandotte,

etc.) under the personal direction of the advertising manager of each organization.

The result . . . a 124-page documented report, authenticated by J. K. Lasser & Co., nationally-known auditing firm. The report covers the buying influences for six major CPI product and service categories (chemicals and raw materials, processing equipment, materials of construction, operating supplies, services, etc.) . . . each in turn broken down into specific components.

To receive your personal copy of this authoritative CPI Buying Pattern study, address Director of Research, CHEMICAL ENGINEERING - CHEMICAL WEEK, on company or agency letterhead.

### CHEMICAL ENGINEERING

*...for engineers in all functions*

### CHEMICAL WEEK

*...for management in all functions*

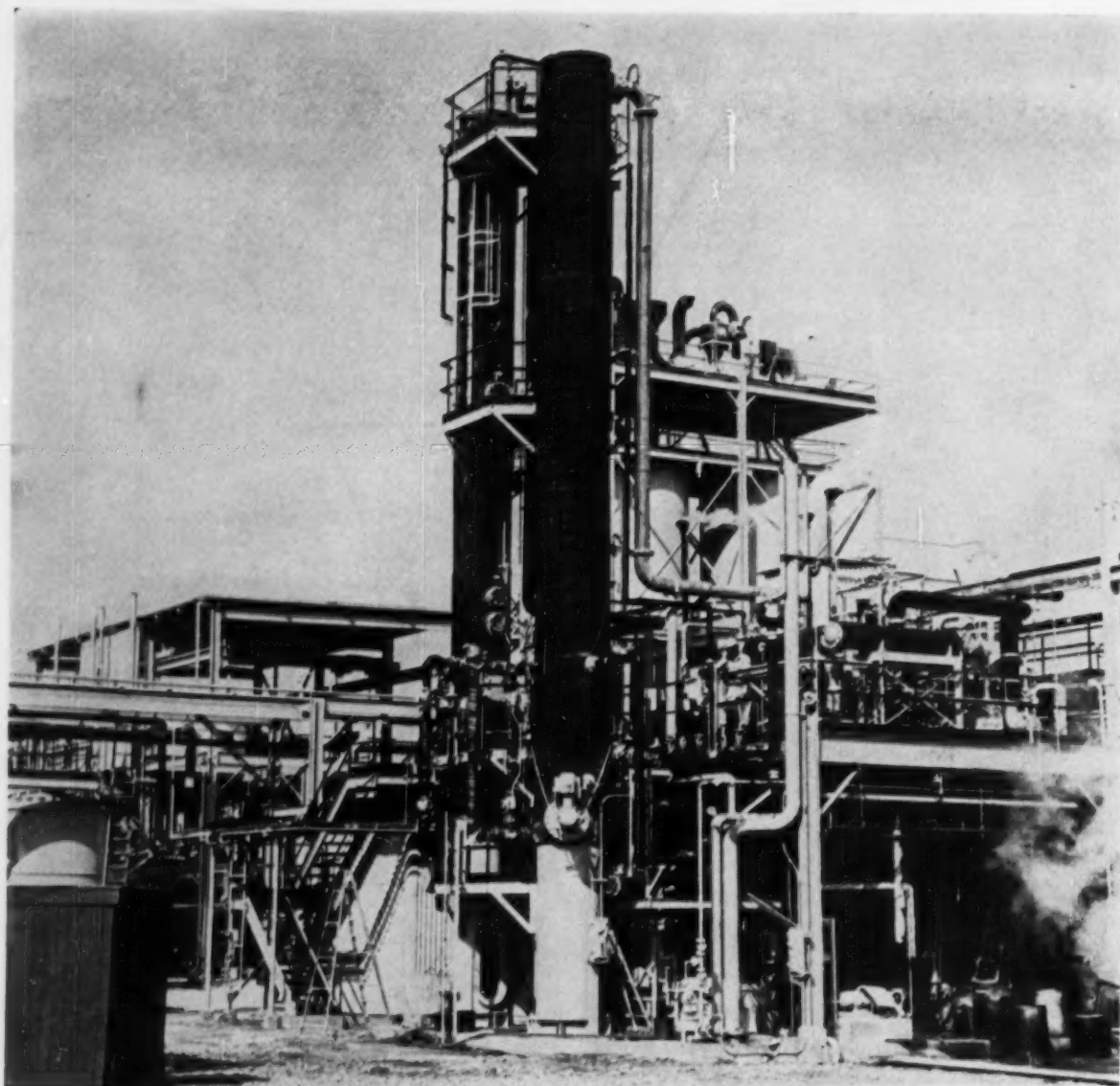
MCGRAW-HILL PUBLICATIONS (ABC-ASP) 330 WEST 42 STREET, NEW YORK 36, N. Y.



Buying Influences and Magazine Preferences Among 29 Leading Chemical Manufacturers







## Product spoilage eliminated in phenol plant by *Carpenter* Stainless Tubing !

Oxide discoloration was imparted to the phenol by carbon steel tubes first used in this phenol plant. A change to Carpenter Stainless Tubing has ended this problem permanently. Compare Carpenter quality, and you'll install Carpenter Stainless Tubing for your own processing applications.

MEMBER



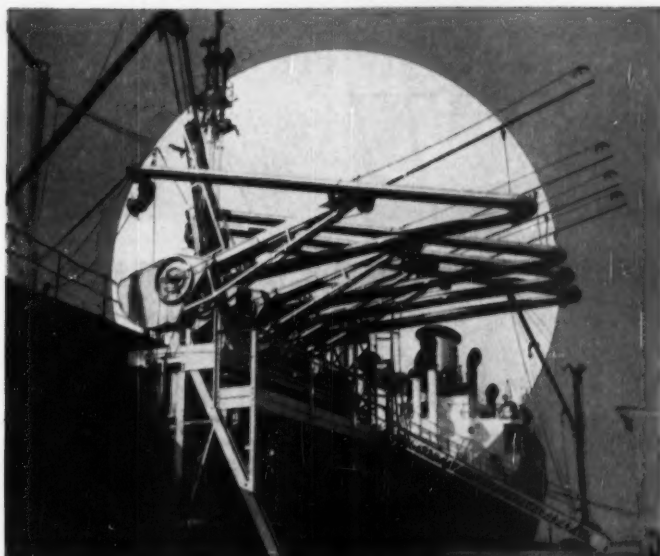
The Carpenter Steel Company,  
Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N.Y.—"CARSTEELCO"

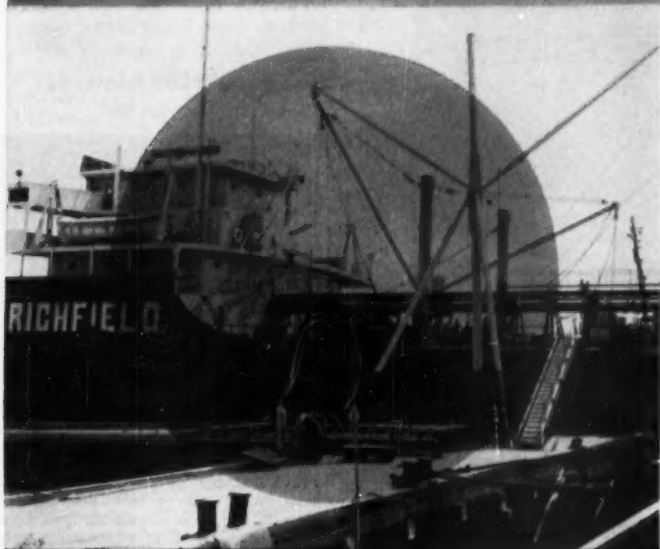
*Carpenter*


### Stainless Tubing & Pipe





**NOW**—One man operating simple controls swings Chiksan Loading Arms into hook-up position in one minute. Note spotless condition of the dock.



**BEFORE**—Unwieldy dock hose was difficult to make up, was hazardous, cluttered the dock and was subject to spillage.

# CHIKSAN

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION



**CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY**

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Company • Chiksan of Canada, Ltd.

## **RICHFIELD TERMINAL GOES MODERN WITH *CHIKSAN* MARINE LOADING ARMS**

Safety. Economy. Speed. These three major factors were carefully weighed by Richfield when they evaluated the new Chiksan Marine Loading Arm. On each point the new Loading Arm measured up and more.

Take safety. The majority of marine loading mishaps are back injuries resulting from handling heavy rubber hose. The new hydraulically operated loading arm eliminates this costly hazard. Hose bursts, while less common, are extremely dangerous, terrifically expensive... one burst cleanup could easily cost more than an entire 5-arm unit. The new Chiksan Loading Arm has a burst ratio of 8 to 1 compared with rubber hose 4 to 1 ratio.

From a speed standpoint, it takes 3 men just 7 minutes to make up the Chiksan Loading Arm compared with 7 men taking 24 minutes with rubber hose. Loading operations can be speeded up, materially reducing turnaround time.

And from the all important economy viewpoint, the new Loading Arm means substantial savings in lost man-hours due to injuries, insurance and compensation premiums, and expensive rubber hose replacement costs. Savings that within a decade will actually amount to the purchase price of the Loading Arm.

### **CONSULT CHIKSAN NOW**

If your planning includes a new dock, Chiksan will provide specific detail so that installation requirements can be included in the original plans. If it's an existing dock, Chiksan will tailor loading facilities to meet your requirements.





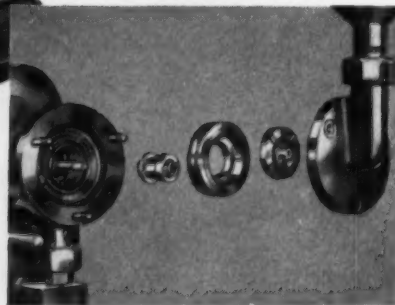
# NEW!

## GAULIN RE\* COLLOID MILL



This is the Model 2A. It is shown with accessory equipment — stainless steel 3-way valve, by-pass tubing and tank — for processing quantities as small as 8 oz. Extremely useful for laboratory and research work, it is also designed for production work within its capacity range. Mill body is water jacketed for either heating or cooling.

### The Special PLUS Features of the Gaulin RE\*



Exclusive! Removable rotor, stator and shaft seal can be disassembled without tools. Shaft leakage is eliminated — There is positive sealing even when processing volatile organic liquids.

Here's a brand new concept in Colloid Mills — the Gaulin RE\* with removable rotor, stator and shaft seal. The horizontal two-stage design gives maximum capacity per horsepower and unusual processing efficiency. Result: The Gaulin RE\* Colloid Mill greatly simplifies operation, can be cleaned without tools, has minimum maintenance, positive shaft sealing and greater production per dollar invested.

#### Special Materials Available

Rotor and stator can be furnished in stainless steel, tungsten carbide, ceramic, alundum and other special materials. Removable feature makes parts interchangeable.

#### Wide Range of Capacities

The Gaulin RE\* has a capacity range from 0-2600 gph. Model 2A: 0-310 gph; Model 4A: 0-1000 gph; and Model 8A: 0-2,600 — all depending on product, specifications and gap setting.

#### Send for New Bulletin

Put this new Colloid Mill to work for you! Complete data on the RE\* line is available in a special bulletin. Construction details, capacity data for typical products, and rating curves are included. Ask for C-56 from: The Manton-Gaulin Mfg. Co., Inc., 71 Garden Street, Everett 49, Mass.



\*patent applied for



Special micrometer adjustment — from —.001 to .040 — accurately positions the gap opening between rotor and stator. Adjustment of opening can be made at any time whether machine is running or not — allowing continuous control of processing operation.



# USING DU PONT ELASTOMERS

neoprene · Hypalon® in industry



## New HYPALON®-based paint resists strong oxidizing chemicals, heat, sunlight, discoloration

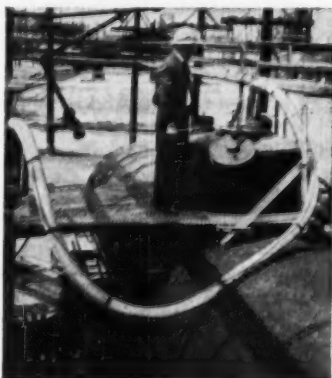
### NEOPRENE hose unloads toluene, minimizes replacement costs

Neoprene hose has long been used successfully at a midwestern chemical plant to unload toluene and other aromatic solvents. According to the plant superintendent, hose replacement costs have been extremely low.

The reason for this exceptional service of a rubber-tubed hose in contact with aromatic solvents can be traced to an unusual characteristic of neoprene, Du Pont's synthetic rubber: *Neoprene recovers its original properties when absorbed solvent is able to migrate to the surface of the hose and evaporate.*

Exposed intermittently and on one side only, the neoprene tube recovers its original properties again and again after each unloading. The hose lasts for several years, and replacement is usually made because of mechanical damage rather than chemical deterioration of the neoprene inner lining. This report on the hose's performance is based on 12 years' experience at this plant.

You will find that neoprene combines many other cost-saving advantages for work in chemical plants—such as resistance to oil, grease, heat and ozone. For more information about neoprene's properties and applications, just clip and mail the coupon at right.



**There's a new kind** of industrial maintenance paint on the market. These paints are based on HYPALON, Du Pont's new synthetic rubber. They resist ozone, strongly oxidizing chemicals, heat and weather. And, what's more important for color-conscious plant engineers and purchasing agents, HYPALON paints come in a range of colors, all of which are stable to sunlight exposure.

HYPALON coatings can be brushed or sprayed. A sprayed coating, applied with standard lacquer or enamel spray equipment, gives a glossy finish and can be built up in the same way as other coatings.

Whichever method you use, you can get colors that start bright and stay bright—applied inside or outside of your plant. They can be used to color-code piping systems or to color-condition equipment. In all cases, equipment is protected by a

resilient, long-lasting coating. Result—reduced plant maintenance costs.

We'll be glad to send you a list of suppliers. Write "Suppliers list" on the coupon. Clip the coupon, also, for information on the many other uses for HYPALON.



**EASY TO APPLY.** HYPALON coatings are brushed or sprayed on like enamel. They add bright, light-resistant color and long-lasting protection to your plant equipment.



HYPALON is a registered trademark of  
E. I. du Pont de Nemours & Co. (Inc.)

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

☐ I am particularly interested in \_\_\_\_\_

☐ Please add my name to the mailing list for your free publications, "The Neoprene Notebook" and "Facts about HYPALON."

E. I. du Pont de Nemours & Co. (Inc.)

Elastomers Division, Dept. CE-12

Wilmington 98, Delaware

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Firm \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

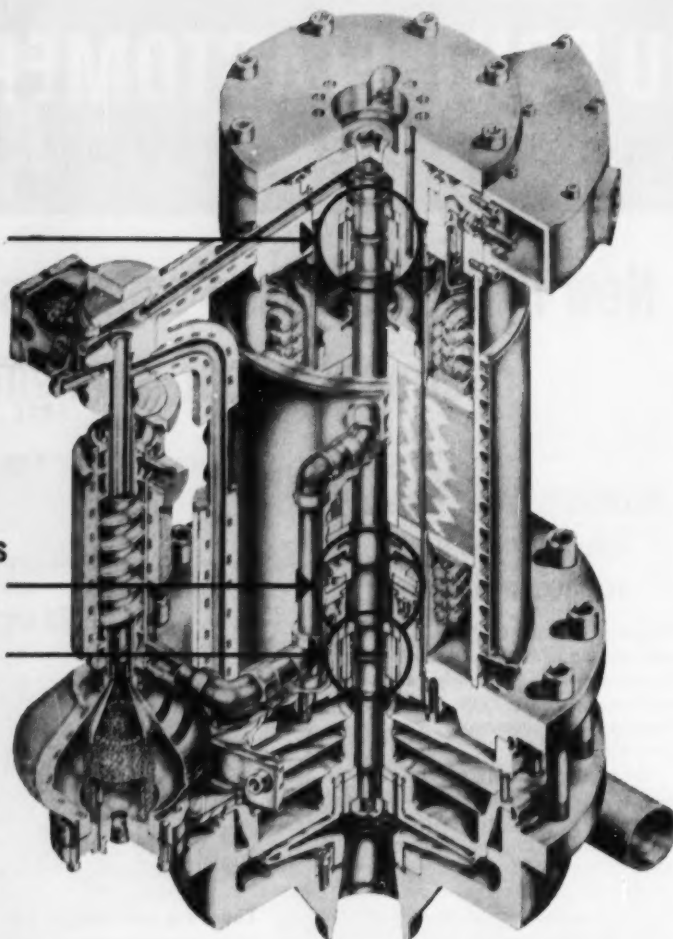




# Both KENNAMETAL\* and KENTANIUM\* in Westinghouse LIQUID METAL pump

Bearings and thrust runners  
operate perfectly after 2000 hours  
handling sodium, NaK and  
other metals at 1050°F and above

Cut-away view of Westinghouse pump to handle liquid sodium, NaK or other metals at temperatures up to 1500°F. Circles show bearings and thrust runners of Kennametal and Kentanium, which meet the most rigid specifications of tolerances and quality of material to provide continuous, 100% leak-proof pumping operation for extended periods.



Kennametal and Kentanium are sharing in one of the engineering advancements of the year . . . the Westinghouse centrifugal liquid metal pump designed for the atomic power industry. Kennametal grade K9\*\* and Kentanium K138A\*\* were selected for the vital bearing and thrust runner parts which are lubricated by liquid metal with a film much thinner than oil lubricants. Surfaces must not corrode and must be highly wear resistant to maintain leak-proof seals . . . rugged requirements which Kennametal and Kentanium have met under grueling tests.

**RUGGED ENDURANCE TEST:** After 500 hours of operation with the pump stream at 1050°F (and 120 psi head), the pump was taken down and the Kennametal and Kentanium parts examined. They showed no change. Now, after 2000 hours of around-the-clock operation, these parts continue operation in apparent perfect condition. Larger

Westinghouse pumps now being built to handle sodium and NaK at 4000 gpm and 1500°F at 250 psi pump head include similar parts of Kennametal and Kentanium.

These applications suggest the use of Kennametal or Kentanium wherever two surfaces rub together or are forced together . . . especially under severe conditions as encountered in handling liquid metals or other difficult-to-handle materials. Such applications might include valve seats, rings, bushings, sleeves on shafts, etc. Kennametal engineers are prepared to assist you. They have years of accumulated experience in the development of hard carbide metals to meet special requirements. We invite the opportunity to serve you. Call or write KENNAMETAL Inc., Dept. CE, Latrobe, Pennsylvania.

\*Trademarks of a series of sintered tungsten and titanium carbides.

\*\*Approved, Bureau of Ships Specification, Carbide Stocks for Bearings, MIL-C-18482, 20/4/55.

B-11410





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# Futures With CHALLENGE!

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It Their Business To Hear  
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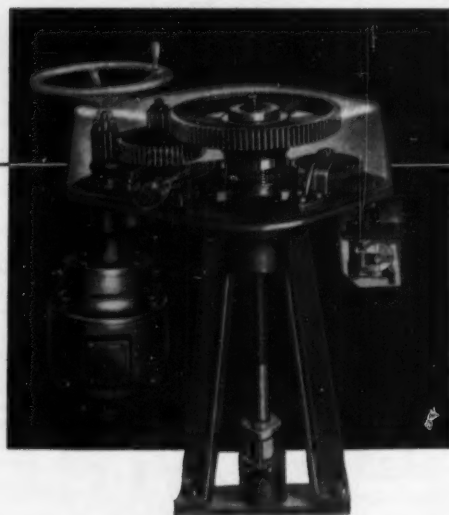




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MOTOR UNITS**

**...for Valves, Floorstands,  
and Sluice Gates**



It's a matter of simple mathematics. Take any one of Chapman's Motor Units and look it over carefully. You'll find approximately half as many parts as with any other make. This means the chances of cutting maintenance costs are two to one in your favor.

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**THE  
CHAPMAN**  
**VALVE MANUFACTURING CO.**  
INDIAN ORCHARD, MASS.





**New Alkyds:**

**WASHABILITY—WITHOUT LOSS OF GLOSS**

New oil-modified alkyds—made with epoxy phenolic ethers and *Glycerine*—offer unusual resistance to solutions of soaps, alkalies and synthetic detergents. What's more, these new resins are said not to lose their gloss after exposure to the atmosphere.

The new alkyds, described in a recent patent\*, are made by heat treating components of conventional oil alkyds with a glycidyl mono-hydric phenolic ether or other ethers containing an alkyl epoxide group. A

typical formulation contains *Glycerine*, soybean oil, glycidyl ether of p-octyl phenol, and phthalic anhydride.

Surface coatings made with the new alkyds retain all the properties for which *Glycerine*-based alkyds are so well known—flexibility, toughness, adhesion and durability—plus added chemical resistance and gloss retention. In tests, the new resins were unaffected by a wide range of chemical agents which damaged other alkyd coatings.

Here again, *nothing takes the place of Glycerine.*

\*U. S. 2,731,429

This balanced group of properties keeps

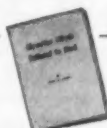
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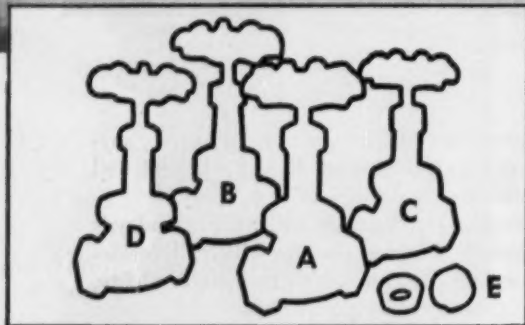
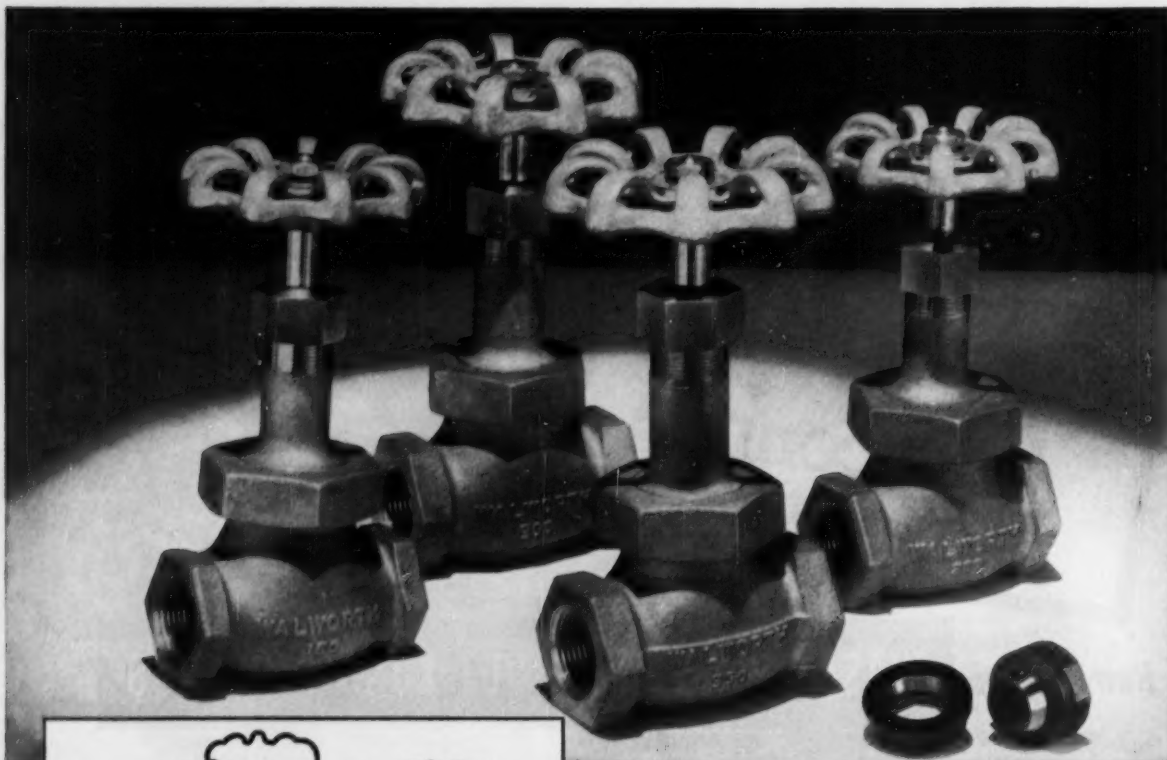
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 E—“500 Brinell” Stainless Steel Plug Type Seat and Disc

Walworth offers four lines of Bronze Globe Valves with stainless steel, plug-type seats and discs. Advantages of these valves include:

- **Stainless Steel Plug-Type Seats and Discs**, heat-treated to a minimum of 500 Brinell hardness reduces wire-drawing to a minimum. Seats and Discs are machined and fitted simultaneously, assuring perfect mating.
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For Longer Bronze Valve Life . . .

## “500 BRINELL” PLUG-TYPE STAINLESS STEEL SEATS AND DISCS

150 lb.      200 lb.      300 lb.      350 lb.

- **Oversize Stems**, made of high tensile strength silicon-bronze, assure long life.
- **Rugged Body Hexes**, are flat on top; do not interfere with wrench gripping body-to-bonnet union ring connection.
- **Bodies**, made of Composition M bronze (ASTM B61), have ample wall thickness to provide high safety factor.
- **Patented Handwheels** are air-cooled and designed with a “finger-fit grip.” Makes turning easy even when wearing greasy gloves.
- **Identification Plates** secured by lock-washer under stem nut, show Figure Number of valves and make re-ordering sure and easy.

FOR COMPLETE INFORMATION, SEE YOUR WALWORTH DISTRIBUTOR OR WRITE FOR ILLUSTRATED CIRCULAR

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by welding*

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**WHY IT PAYS...**



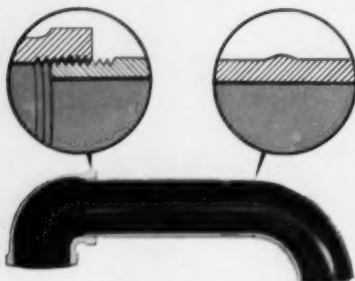
# SMALL DIAMETER PIPING... why it pays to specify welded construction with TUBE-TURN Fittings



**NEVER LEAKS.** Welded joints are permanently as strong and leakproof as the pipe itself. Photo shows welded lube oil lines for one of four diesel engines, replacing threaded lines which leaked. If welded in first place, would have saved \$4000 replacement cost. Pipe is 2½" with TUBE-TURN Fittings.

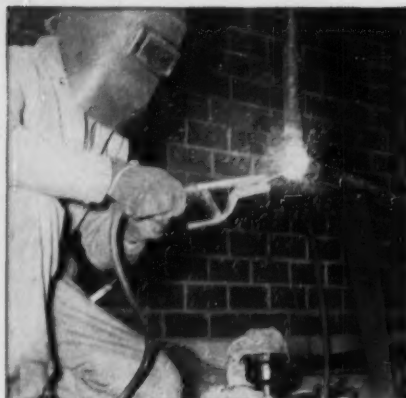
THREADED JOINT

BUTT WELD JOINT



CUTAWAY SECTION  
OF 2" SCHED. 40 PIPE

**SAVES MATERIAL.** Threading cuts half of pipe wall away as shown. The welded joint is as strong as the pipe. An installation of Schedule 40 pipe, welded, is stronger than Schedule 80 threaded. Hence, for equal strength welded piping can cut material costs 30-50%.



**TAKES LESS TIME** to weld than to thread pipe above 2" and about equal time for smaller sizes, according to recent tests on hundreds of joints made by many different pipe fitters. Welded joints in 1½" piping such as the school heating line shown, averaged 7 minutes compared to 8 minutes for threading and tightening fitting.



**IS COMPACT, NEAT.** This installation of 1½" and 2" boiler blow-off piping shows ability to nest welded lines close together for better layout and streamlined appearance. Also, insulation, where needed, is easier to apply.



**TOOLS ARE SIMPLE.** Small, inexpensive welding outfits can cut, weld, heat to bend, solder or braze. They are easy to haul to job and simple to use. All pipe for this factory radiant heating system was fabricated on the site.



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**MORE INFORMATION**—This bulletin gives helpful information on "The Economics of Welding Small, Noncritical Pipe". Mail the coupon for your free copy.



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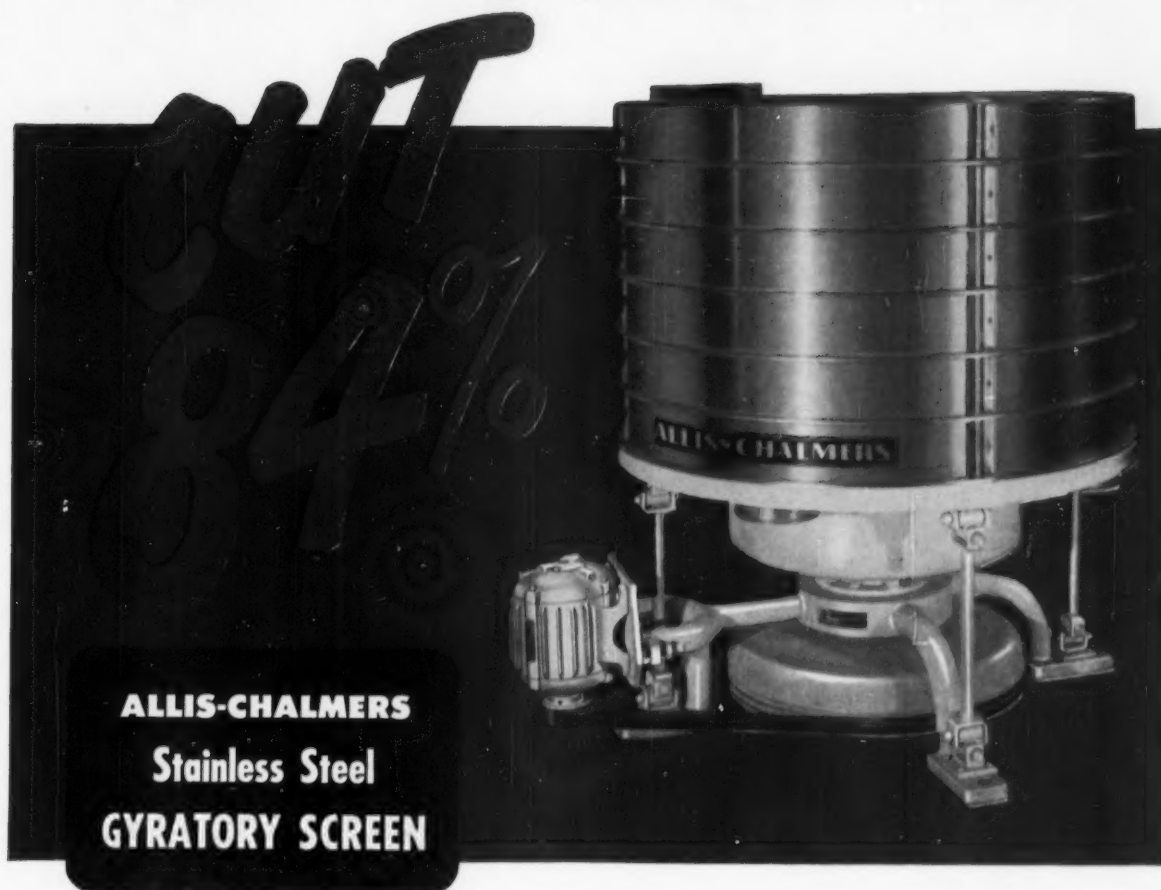
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# Space Requirements



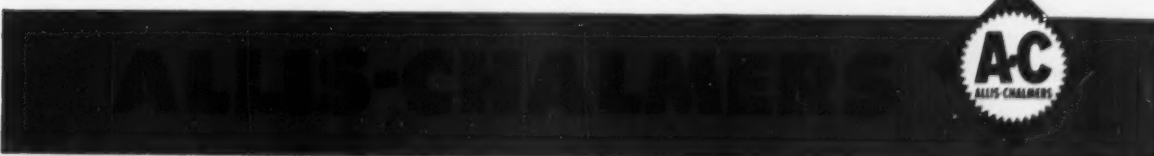
## Eight Allis-Chalmers Units Do Same Job Formerly Done by Sixteen Electro-Magnetic Screens in Large Chemical Plant

**I**N THIS installation — as in most plants where screening is done — two factors make this remarkable achievement possible. (1) The stacked-deck design of the Allis-Chalmers stainless steel gyratory screen provides up to 35 square feet of screening area in just 16 feet of floor space. (2) The gentle but thorough gyratory action provides maximum capacity by exposing product to entire screening area.

**Noise Level Greatly Reduced** — The comparative quietness of the Allis-Chalmers gyratory screens was apparent as soon as they were installed. In these units, a dynamically

balanced mechanism assures quiet, vibrationless performance. Operating economy (low power requirement) was another advantage gained in the change to A-C screens.

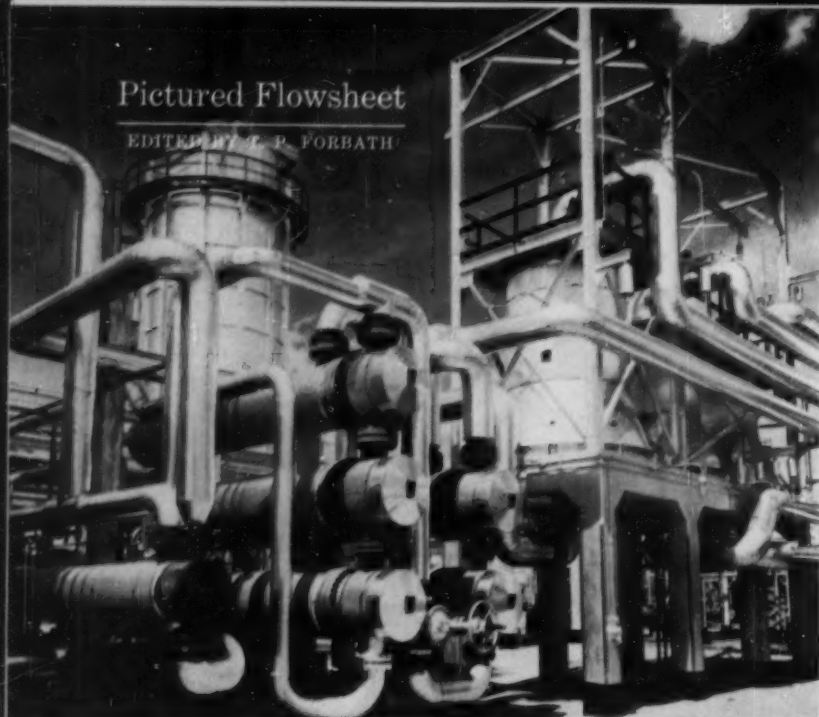
**Improved Quality Control** — In addition to top screening efficiency and economy, this newest and finest of mechanical screens is built to give you profit-insuring quality control and quick, sanitary, simplified maintenance. Get the complete story. Contact your nearby Allis-Chalmers representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. Ask for Bulletin 07B8446.





## Pictured Flowsheet

EDITED BY T. P. FORBATH



Reactors—common base for new touches that make . . .

## Cat Reformers Hit Top Octanes

Souped-up versions of fixed-bed catalytic reforming processes go on stream to produce 100-plus octane fuels.

Detroit's annually "hotter" engines are whipping the already brisk octane derby to an ever more furious pace. Yet refiners continue to run spiritedly ahead of the auto makers. Those third pumps sprouting at filling stations offer octane-number fuels well above the needs of the most "hopped-up" cars to date.

To hold the lead, refiners have been doing some hopping-up of their own, and so have pushed basic, catalytic reformers\* into the 100-plus octane class.

Some of the innovations use mild operating conditions, reach top octane numbers by adding reformat-treating stages to established processes. Others hit super-fuel levels by reforming under severe conditions once called impractical.

► **Newest Entries**—Three of the latest-model cat reformer processes marked commercial gains this summer that should help keep refiners out front:

\*Most of them, e.g., Platforming, Houdriforming, Catforming, Ultraforming, can produce only about 95 clear octane gasolines in normal operation.

• **Rexforming**, Universal Oil's upgraded version of Platforming, took its initial bow at Aurora Gasoline's Detroit refinery, encored soon after at Cosden Petroleum (Big Spring, Tex.). Aurora's 5,500-bbl./day unit and Cosden's 4,000-bbl./day unit get the 100-plus octane fuel by extracting aromatics from Platformate, recycling low-octane paraffins through Platformer for second pass.

• **Iso-Plus**, Houdry's high-octane variation on Houdriforming, also went commercial for the first time. A 4,000-bbl./day unit delivers 100-plus octane motor fuel at SAROM's Ravenna, Italy, refinery by thermally reforming Houdriformate.

• **Powerforming**, Esso's top-octane entry using severe reaction conditions, set out on an ambitious world-wide licensing and building program. With five units now on stream, Esso aims to count 20 by 1959 producing 157,000 barrels per day of 101 octane and better fuel.

► **Common Ground**—All three

processes center around fixed platinum-catalyst bed reforming where naphtha stocks feed continuously through catalyst-packed reactors in a hydrogen atmosphere. Fixed beds hold favor because platinum, the most effective reforming catalyst, is too expensive to risk losing in moving or fluid beds.

Upgrading springs mainly from reforming reactions that produce aromatics: (1) dehydrogenation of six-membered naphthenes; (2) isomerization of five-membered rings to six, followed by dehydrogenation; (3) dehydrogenation of paraffins followed by cyclization.

Supporting reactions—paraffin isomerization and desulfurization—improve lead susceptibility; paraffin hydrocracking increases volatility.

► **Different Wrinkles**—Powerforming's severe conditions require regeneration of the catalyst. Rexforming maximizes the dehydrocyclization reaction by extracting aromatics from Platformate, recycling low-octane stream. Iso-Plus' thermal alternative cracks long-chain paraffins to up octane number. Other two, like Rexforming, extract aromatics.

► **Hooking in Rexformer**—Aurora converted an existing Platformer to Rexforming by adding an aromatic separation unit, thus boosted unleaded reformat from 87 to 97 octane. With leading, Aurora's fuel tests 102.4 on the newly extended scale.

Midcontinent naphtha feeds to a prefractionator. The heart cut represents part of the feed, recycled paraffinic raffinate from the aromatics separation unit is the rest. Combined charge mixes with hydrogen, then proceeds from a furnace preheater through the four catalyst filled reactors and three intermediate heaters that make up the Platformer section. Rexforming reactor conditions, milder than Platforming alone, are 800-950 F., 300-600 psig.

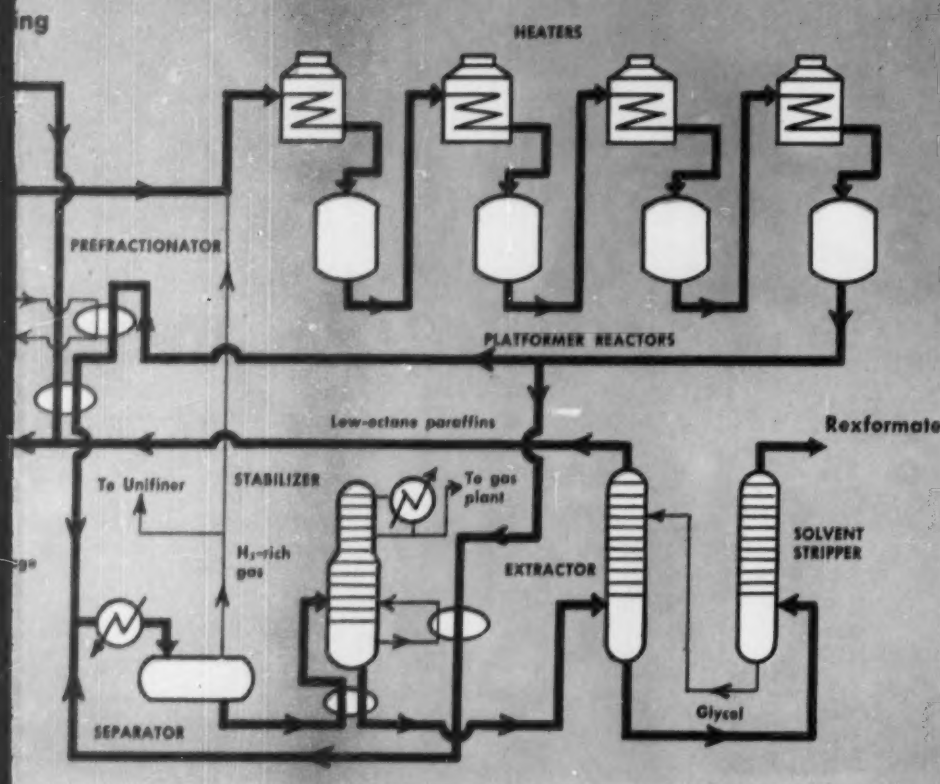
Reformat from last reactor flashes hydrogen-rich vapor, which splits into two streams. One recycles to the feed stream, other goes to an amine treater (Unifiner) to remove H<sub>2</sub>S. Reformat is debutanized, then charged to the aromatics separation unit.

Stream contacts an aqueous glycol solution in an extractor.









paraffins pass as top of the column the prefractionator trip through the product goes to a stripper to recover stripped reformate for leading.

**Iso-Plus Route**—Following the refining Iso-Plus Iraq naphtha.

400-psig. hydro- through a pre-guard-case, plat- tor. Sulfur in erted to  $H_2S$ , lead yst poisons are and unsaturated re hydrogenated. from the effluent.

naphtha then e-reactor, three- ormer. Combined n, stream is F. in first heater. t reactor as a ked vapor, leaves flash off recycle vapor in a sepa-

bes to a depro-

panizer, then to a depentanizer. Butanes and pentanes are blended further along the flow with thermal reformat. From depentanizer, reformat splits into two streams. Bulk charges to the thermal reforming section of the plant, rest is used as blending stock elsewhere in the refinery.

In the thermal unit paraffins crack without effecting aromatics. Stream then flashes off propylene in a stabilizer, bottoms charge to debutanizer. Overhead butene and propylene go to a catalyst polymerization unit which produces "catpoly" gasoline for blending with reformat stream. Final high-octane fuel thus is a blend of debutanized thermal reformat, pentane-butane and catpoly gasoline.

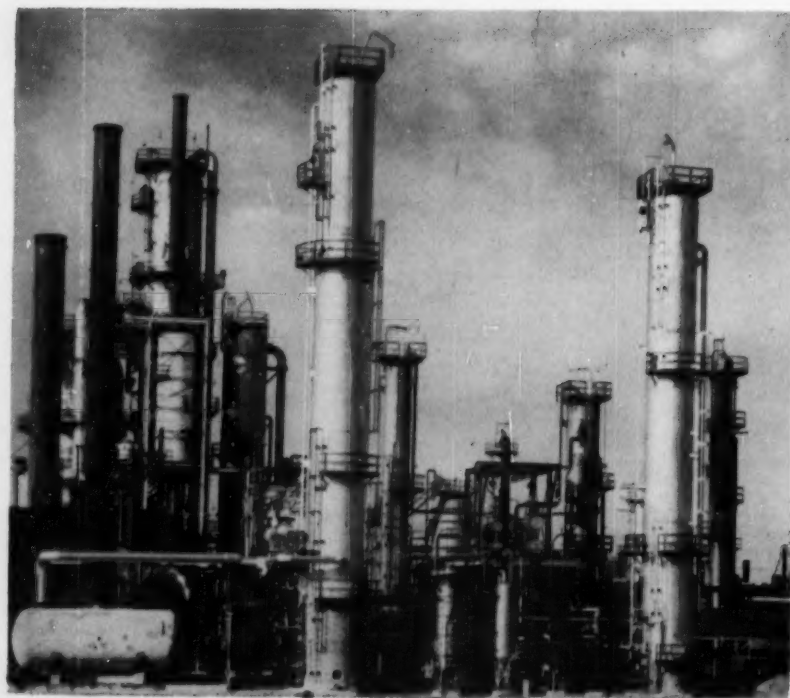
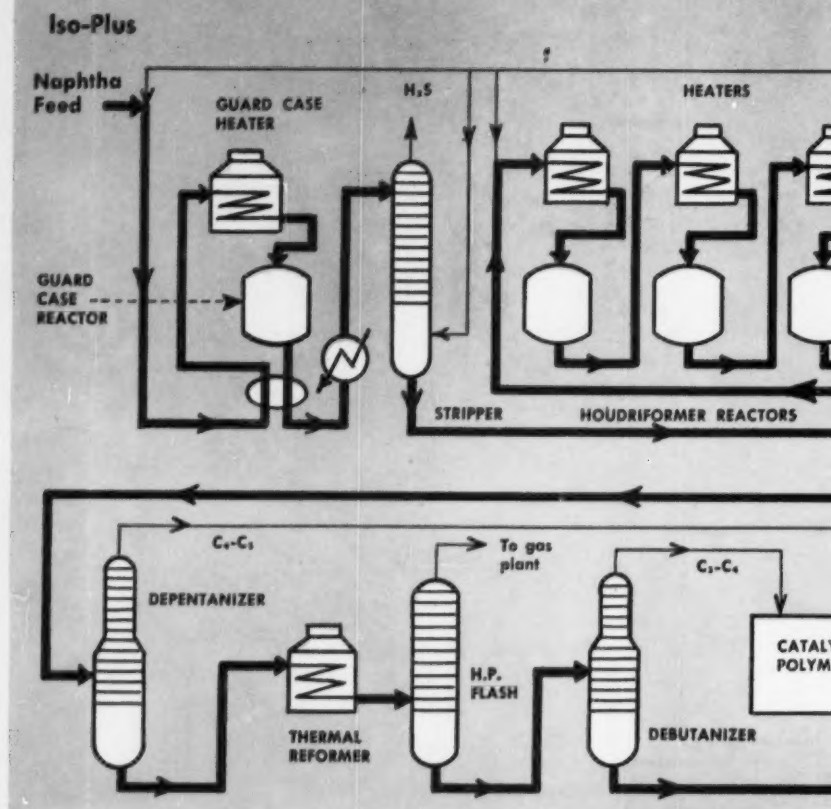
► **Severe Powerforming**—Esso's regeneration scheme and new platinum catalyst at its 3,000-barrels per day Baltimore Powerformer permit severe enough reforming to get 98 clear, 103 leaded octane fuels without added treating stages.

Temperatures exceed 1,000 F., pressures are higher than 1,000 psig. as compared to about 850 F. and 600 psig. of other processes.

Cracked crudes feed through a hydrogenation column (Hydrofiner) to saturate olefinic compounds and convert sulfur to  $H_2S$ . After a flash step the feed passes to an absorber stripper which removes the  $H_2S$ .

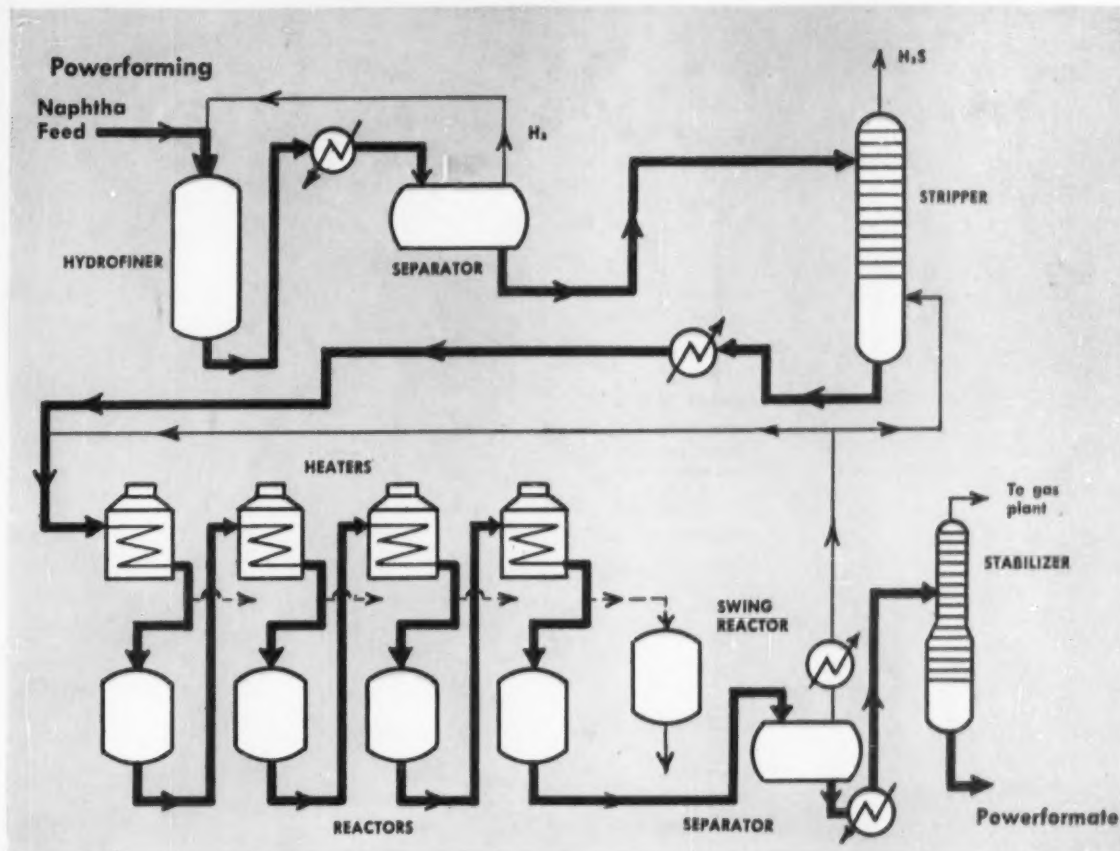
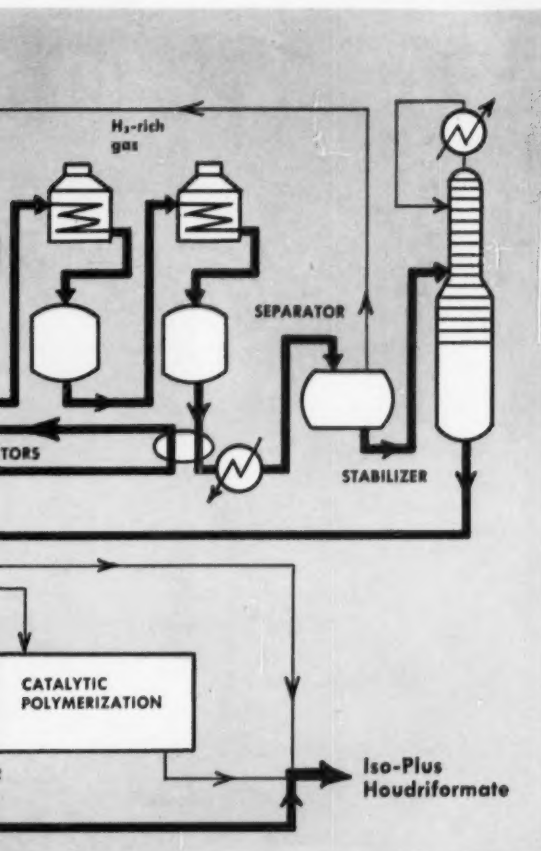
Desulfurized stream proceeds through four catalytic reactors and their associated intermediate heaters. A fifth (awing) reactor can cut any of the other four out of the flow and take its place while it is being regenerated. Thus catalyst regeneration doesn't interrupt production. Cycle on any one reactor varies with the feed from 5 to 15 days, catalyst retains its initial high activity indefinitely.

Reformat from final reactor flashes in a separator. Hydrogen rich vapor recycles to the stripper. Reformat is then debutanized and ready for leading.

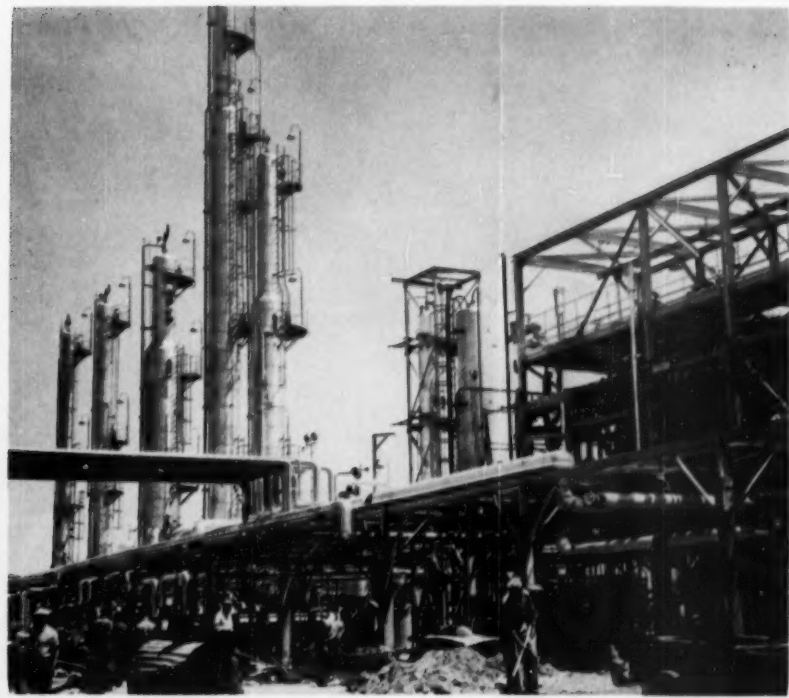


**1** REXFORMING unit at Aurora Gasoline, Detroit, springs from extraction unit hooked on Platformer to remove aromatics from catalytic reformat stream.

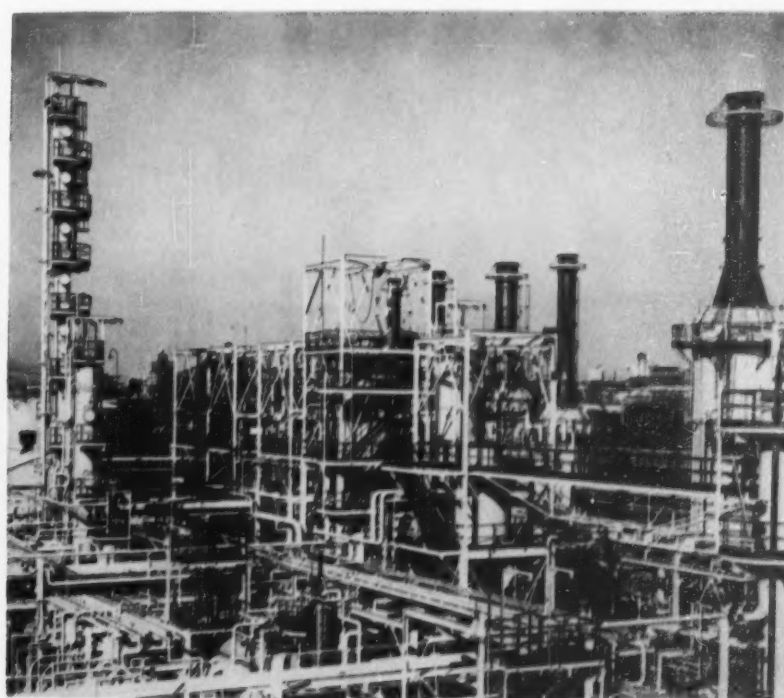




unit  
eam.



**2** ISO-PLUS plant at SAROM, Ravenna, Italy, takes catalytic reformat from Houdriformer section and thermally reforms it to get high-octane gasoline.



**3** POWERFORMING at Esso's Baltimore refinery requires very severe operating conditions. Continuous regeneration keeps bed activity high.





## THE CHALLENGE OF THE BLUEPRINT

The engineer calculates stresses in high-pressure piping and designs for safety. To be sure of this safety he writes "Flexitallic" Spiral-Wound Gaskets on his drawings of the flange connections.

It is this confidence of the engineers — this challenge of the blueprint — that makes our job of maintaining Flexitallic standards of quality so important.

Each Flexitallic Gasket is designed to meet specific conditions of thermal and mechanical shock, corrosion, vibration, weaving, and to meet unpredictable joint stresses. Spiral-wound V-crimped plies of required metal with alternating plies of proper filler result

in a gasket with compression characteristics like those of a precalibrated spring.

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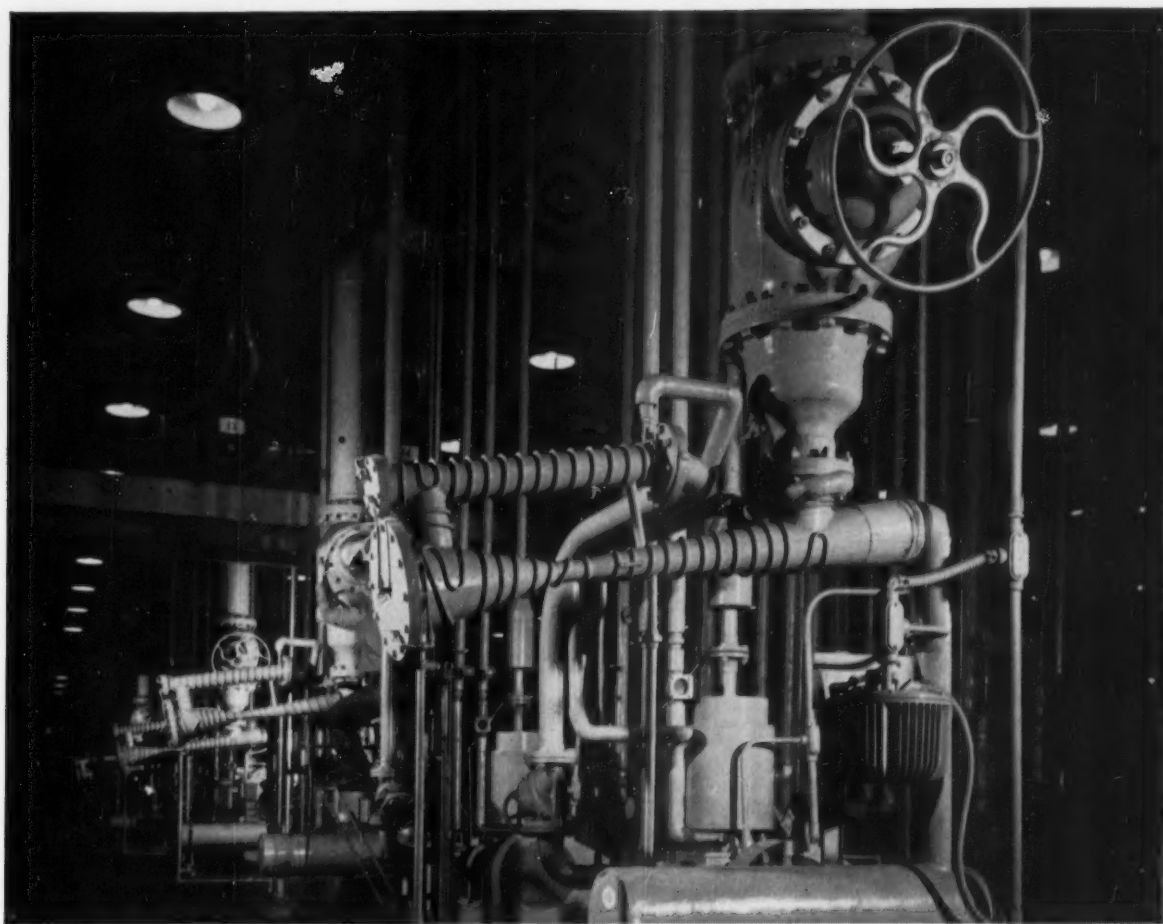
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FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

\*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for Flexitallic Blue—it's our exclusive blue-dyed Canadian asbestos filler.





## These Crane valves holding 25 microns absolute pressure after 2 years on vacuum service

**The Case History**—Valves frequently are the most critical points in a vacuum system. But that's not the case with this large Southern light metals refiner.

This plant reports no trouble or expense over a 2-year period in maintaining a vacuum of less than 25 microns absolute for its distillation process.

The tight-holding valves installed about 2 years ago on the lines from vacuum pumps shown above are Crane No. 1611 diaphragm pattern. These 12-in. packless iron body valves are used about once daily.

They've allowed no in-leakage at the seat, bonnet-joint, or through the diaphragm. No maintenance whatever has been given the valves since installed. They operate easily and look good for such service indefinitely.

This high efficiency performance is mainly due to Crane separate disc and diaphragm design. The diaphragm used as a bonnet seal only is not subject to destructive crushing. Conventional type disc and body seat provide a metal-to-Neoprene seating that's ideal for vacuum and hard-to-hold fluids.

Moderately priced, Crane diaphragm valves deserve your consideration for many ordinary services, as well as sludges, slurries and corrosive fluids. They are made in a wide variety of body and trim materials, in ½ to 12 in. sizes.

Ask your local Crane Representative about them, or write to address below for literature.



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view of the double  
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THE modern Raymond Roller Mill, built with an integral Whizzer Air Separator, provides a most efficient type of pulverizing unit for chemical processing plants that are being "tooled up" for peak production of powdered materials.

The Whizzer feature permits a wide range of classification from 60% minus 100 mesh up to 99.99% passing 325 mesh or better. Adjustments may be made while the mill is running, and the fineness held to close uniformity in making special high grade products.

For handling materials containing surface moisture, the Roller Mill may be equipped with Flash Drying accessories to reduce the moisture content to a fraction of 1% while grinding. This combination unit performs the entire process in a single, automatic, dust-free system.

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## Names in the News

EDITED BY M. A. GIBBONS



### Man of the Month: Henry S. Winnicki

**Former director of engineering and development for FMC Chemicals becomes president of new organic chemical division.**

Technical skill coupled with a ready knack for adjusting to new people and places—together these factors neatly round up the reasons why Henry S. Winnicki, at 44, is now president and manager of Food Machinery & Chemical's new organic chemicals division.

Because the new section would unite for the first time in FMC history all organic chemical operations, the firm needed a man who had much more than technical skill alone.

To head up any new operation is to do so largely without precedent; and this calls for a man whose way of thinking and working is fairly flexible—someone whose reflexes in new situations are quick and sure. And, perhaps what is more important, the

situation calls for someone who really gets along with people.

Winnicki has had plenty of practice developing all of these traits.

► **Overseas**—Take his European assignment for example. FMC sent him to Geneva in 1953 as its first European resident representative for the firm's chemical divisions. During the next two years, he tracked down many interesting potential projects—in both organics and inorganics—for FMC's possible investment. Some of these projects, mostly in Holland and Germany, have since been translated into pilot and plant developments at various FMC locations.

Vice president Seaton claims that one of the most significant reasons for Winnicki's success

overseas was the rare combination he has of being "extremely talented technically while having equally good talents with people." His feeling for people is broad enough and deep enough so that getting himself accepted into the European scheme of things posed no real problem at all. In no time, many business associates all over the Continent became close personal friends.

Seaton recalled one week in October of this year, when Dutch, Italian and German friends dropped in at different times to see Winnicki while on business in New York.

► **Not An Onlooker**—Wherever he went, says Seaton, Winnicki managed to fit easily into the European scene. Seaton especially likes to cite one carnival festival in Cologne as an example. Winnicki and his wife went not as foreign spectators but as participants. He remembers watching them have a whale of a good time in full costume amidst a flock of happy, singing Germans.

Through his friendships, Winnicki saw a lot more of Europe than he probably could have seen on his own. Occasionally, he and his family went along with close friends on jaunts to see the more interesting areas—off the beaten track—through northern Italy, Scandinavia and Switzerland.

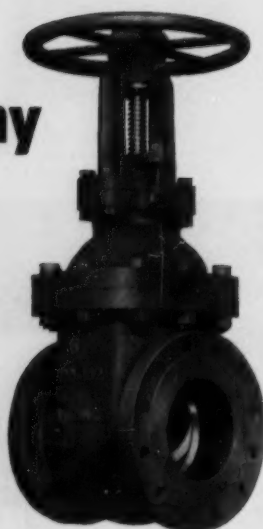
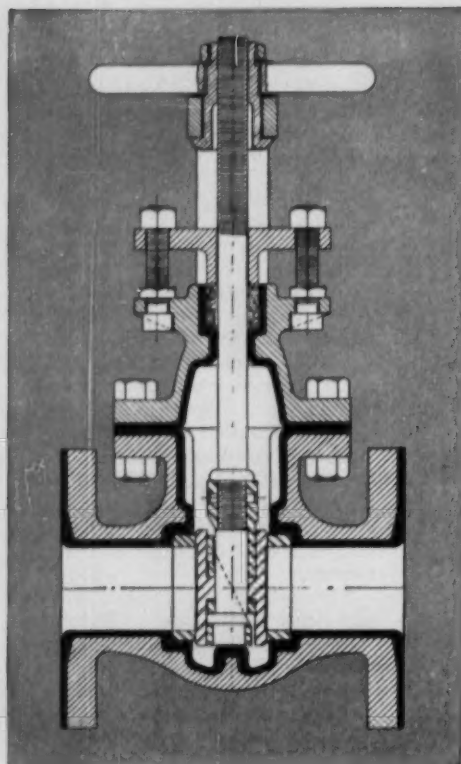
And, being an integral part of the European community affected the family all the way down the line. The two oldest children spent some time living with Dutch and German families during the school year. (Now, to return the compliment, the Winnickis will soon have as their guest, here in America, the daughter of a German chemist.)

► **Technical Experience**—Winnicki's record in industry, alone, went a long way toward recommending him for his new job.

From 1943 till 1950, he headed up chemical engineering activities in Westvaco's central engineering department in New York. During that period he was involved in all of Westvaco's plant expansions and changes. He took charge of the team that



# FOR double economy in corrosive service



• Darling rubber-lined iron body gate valves, with special alloy working parts, offer trouble-free corrosive service and big savings. Available in rising stem, cylinder or motor operated, or quick-opening types.

**H**ERE'S a Darling gate valve that can save you plenty of dollars in corrosive services up to 180° F. This is an iron body valve with a hard rubber lining permanently bonded to all exposed interior surfaces, and suitable for working pressures up to 150 pounds.

Equally important, this valve features Darling's *fully revolving double disc parallel seat principle* which is unexcelled for trouble-free performance, tight closure, low maintenance and long life.

Weigh these facts and potential savings, then write for complete data on these job-proved rubber-lined iron body valves.

## DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by  
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



## NAMES . . .

went to the TVA to get information leading to the development of the electrothermal phosphorus process. And, he was also involved in setting up FMC's new process for soda ash (from natural trona).

Seaton characterizes Winnicki's "substantial contribution" to the firm this way: "With an engineer's knowledge and an inventor's perception, he had no trouble in turning the new projects into smooth economical operations. "But," he adds, "if you question him, he probably won't admit having had very much to do with these projects—even though his name is on many of the patents."

► **Organizer**—Taking on a new department with ease is nothing new to Winnicki. Last year, when he returned from Geneva, he set up a central development department for FMC Chemical here in New York. At that time, he worked on such problems as phosphate expansion at Newark, Calif., and chlorine modernization at S. Charleston, W. Va.

And, back in 1950, he engineered the organization of a new general development department for Westvaco Chemical. It was his job to look into a variety of fields in which Westvaco might want to become involved. And, at the same time, he continued overseeing other engineering processes under development by the company. He became active, too, in the early analysis and pre-evaluation of such processes as the production of carbon bisulfide, anhydrous ammonia and nitric acid.

Soon after, as a result of various trips to Europe during this interval, FMC decided that it should have more intimate and continuing contacts there. This was the decision that led to Winnicki's European assignment. ► **Home again**—Now back in the American swing of things again, Winnicki and his family have settled down in the midst of what might be termed an FMC community — in New Canaan, Conn.

Some day, Winnicki says, it would be rather good to get back to an occasional bit of golf or tennis, but so far he hasn't found the secret of manufacturing the extra time he'd need.



His only hobbies, according to Seaton, are an epicure's interest in exploring foods and wines—developed, no doubt, somewhere between the Swiss Alps and the Rhineland—and, of course, the members of family (they get the lion's share of his attention).

**G. C. Szego** has accepted a position as manager of a study group in the advanced propulsion systems section, flight propulsion lab department, in GE's Aircraft Gas Turbine division.

**Alfred D. Bonanno** has been appointed manager of Kelco Co.'s paper division, New York. Under his direction, the firm plans an expansion of its technical service.

**Harold C. Templeton** has joined Alloy Steel Products Co., Inc., manufacturers of corrosion-resistant valves, as chief metallurgist.


**Sidney H. Babcock, Jr.**, has been named manager of manufacturing and process improvement of the fine chemicals division, American Cyanamid Co. Till now, Babcock had managed Lederle Laboratories' overseas operations.

**Thomas Griswold, Jr.**, has been named honorary chairman of the Midland section of the American Institute of Chemical Engineers. Now 86, Griswold has served the chemical industry since 1897 as a bulwark of Dow Chemical Co.

**Shreve M. Archer, Jr.**, and **George K. Nelson** have been elected to the board of directors of the Applied Radiation Corp., Walnut Creek, Calif. Both men are associated with Archer-Daniels-Midland, which has acquired a 50% interest in ARCO.

**Emanuel Sonnenschein** has joined Associated Metals & Minerals Corp., taking full charge of the firm's chemical and fertilizer department.

**Robert R. Gumaer** has joined the research and develop-



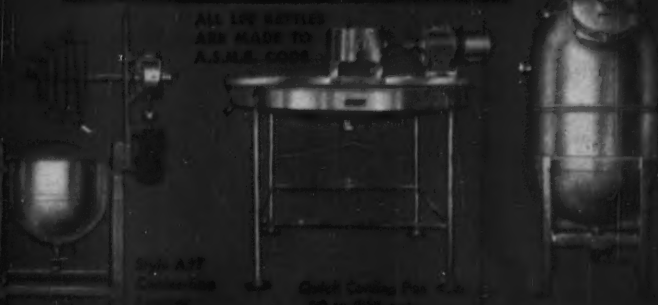
# LEE


## CORROSION-RESISTANT PROCESSING EQUIPMENT

IS

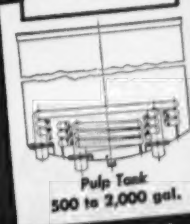
### PRECISION BUILT TO YOUR SPECIFIC REQUIREMENTS TO GIVE LONG YEARS OF PEAK PERFORMANCE WITH LOW MAINTENANCE

WRITE  
for technical  
bulletins fully  
describing  
each of these  
processing  
units.

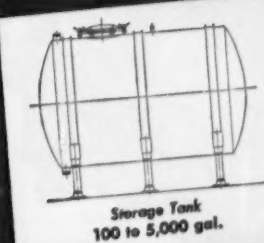




**Mixing Tank**  
25 to 500 gal.



**Pulp Tank**  
500 to 2,000 gal.



**Storage Tank**  
100 to 5,000 gal.

## LEE

**METAL PRODUCTS CO., Inc.**

317 Pine Street

Philipsburg, Pa.

ALL LEE REFILES  
ARE MADE TO  
A.S.M.E. CODE



# 'Delanium' Graphite

BLOCK TYPE

## HEAT EXCHANGERS

NOW AVAILABLE THROUGH

DELANIUM  
GRAPHITE  
COMPANY

134 Elmora Avenue, Elizabeth, N. J.

### THE ORIGINAL 'DELANIUM' GRAPHITE HEAT EXCHANGER

**TWELVE VERSATILE  
MODELS**, ranging from 4  
ft.<sup>2</sup> to 200 ft.<sup>2</sup> of transfer sur-  
face in single graphite blocks.  
Passage diameters to  $\frac{3}{4}$ " and  
working pressures to 200 psi.

**DELIVERY FROM STOCK** on most models; only 6 to 8 weeks on  
special orders.

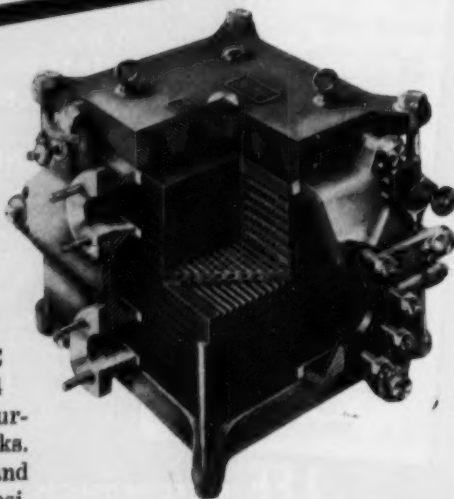
**HIGH DENSITY** impervious 'Delanium' processed graphite by Powell  
Duffryn Carbon Products, Ltd., of Hayes, England.

**COMPACT CONSTRUCTION** with headers easily removed for in-  
spection and cleaning.

**SEND FOR DESCRIPTIVE LITERATURE** on the proven, original 'Delanium'  
Heat Exchanger. A technical staff will suggest solutions for your condensation-  
evaporation, liquid-liquid, liquid-gas heat transfer problems.

'Delanium' is the regis-  
tered trade mark of  
Powell Duffryn Carbon  
Products, Ltd., Hayes,  
England.

**DELANIUM GRAPHITE COMPANY**



NAMES . . .

ment department of the  
American Oil Co., Texas City,  
Tex. Formerly, he had been  
in the employ of Pan-Am  
Southern Corp., as technical  
assistant to the vice presi-  
dent of manufacturing.

Robert W. Gutheil has been ap-  
pointed manager of the ad-  
hesive division of Armour &  
Co. He succeeds C. A. Lewis,  
who is retiring after 36 years  
with the firm.



V. E. Wellman

New manager of American  
Cyanamid's petrochemicals de-  
partment is Dr. V. E. Wellman.

Due to the substantial growth  
of the petrochemical field, Well-  
man will now devote all his time  
to it; formerly, he was manager  
of the intermediates and rubber  
chemicals departments as well.

A native of Denver, Colo.,  
Wellman is a graduate of Phillips  
University, Enid, Okla., and the  
University of Washington. Be-  
fore joining Cyanamid, he was  
associated with B. F. Goodrich.

William D. Sims has joined  
Shell Development Co.'s Em-  
eryville (Calif.) research  
center as an engineer in the  
fuels and engine lubricants  
department. Until recently,  
he was a senior engineer at  
the Wood River refinery.

Tennyson Smith recently joined  
the technical staff of Atomics  
International as a senior re-  
search chemist in the separa-  
tions chemistry unit.

Lauren B. Hitchcock has re-  
signed as president and man-  
aging director of the Air  
Pollution Foundation to re-  
turn to private practice as a



management consultant in industrial research and development.

**William L. Garman** has been appointed vice president in charge of the agricultural chemicals division for the Best Fertilizers Co., Oakland, Calif. **Taylor Darden** has been named assistant manager at the Lathrop, Calif., plant.

**Frederick A. Riehl** and **Donald E. Bisgrove** have been appointed technical representatives for Bakelite's calendering materials division in Boston, Mass., and Clifton, N. J., respectively.



**John J. Healy, Jr.**

Monsanto Chemical has just appointed **John J. Healy, Jr.**, as director of general development for the research and engineering division.

Healy joined the former Merri-mac Chemical Co. (later acquired by Monsanto) in Everett, Mass., in 1921 as a control chemist. By 1947, he had become assistant general manager of the Merri-mac division and, most recently, assistant to the vice president for research, development and engineering.

A native of Boston, Healy went to Harvard and did graduate work at MIT.

**Albert J. Hanssen** has recently been appointed chief engineer, Conoflow Corp., Philadelphia. Before joining the firm, he had been chief engineer of the Climax division, Black, Sivalls, & Bryson, Inc.

**William Krochta**, Purdue University, and **Donald A. Reich**,

Many elements  
attack this plant, but...

# ALUMINUM PAINT PROTECTS...

...against rust, smoke and fume corrosion,  
evaporation of volatiles, and heat expansion

This plant is attacked constantly by corrosive smoke and fumes; by coastal atmosphere that causes rust and corrosion; by the sun's heat. Aluminum paint protects against all of them.

Good aluminum paint actually puts a long-lasting protective shield on rustable metal, masonry and many other surfaces. It guards against plant deterioration. It retards evaporation of volatiles. It reduces heat expansion problems in metal structures. It re-

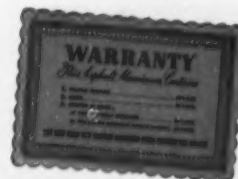
flects heat and light to lower temperatures, makes everything brighter.

Use aluminum paint inside and out. Usually a single coat covers—lasts and lasts—you slash maintenance costs without sacrificing much needed protection.

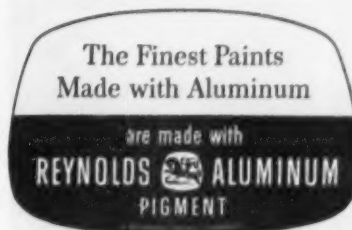
Reynolds Metals Company does not make aluminum paint. If you would like the names of manufacturers who rely on the high quality of Reynolds Aluminum Pigments, we'll gladly send you the list. Just use the coupon below.

#### Aluminum Roof Paints and Coatings Add Years to Roof Life

Asphalt-Aluminum roof paints and coatings provide low-cost, long-life protection for built-up and rustable metal roofs. Also reflect sun's heat to keep buildings up to 15° cooler in summer. Ask the paint salesman to show you his heat reflection demonstration. Insist on Asphalt-Aluminum roof paint or coating with this Warranty Seal. It assures you of an approved vehicle and at least two full pounds of pure aluminum pigment in every gallon.



See "CIRCUS BOY", Reynolds new dramatic series, Sundays, NBC-TV.



**Reynolds Metals Company**  
P.O. Box 1800-PH, Louisville 1, Kentucky  
Please send me information about:

- ☐ Aluminum Paints.
- ☐ Roof Coatings.
- ☐ Also send me list of manufacturers.

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

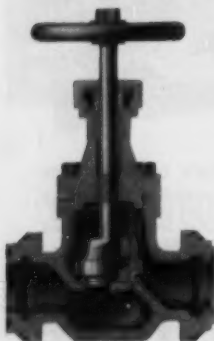
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## Refrigeration

**Serves Velsicol Chemical Corp.  
Three Ways**



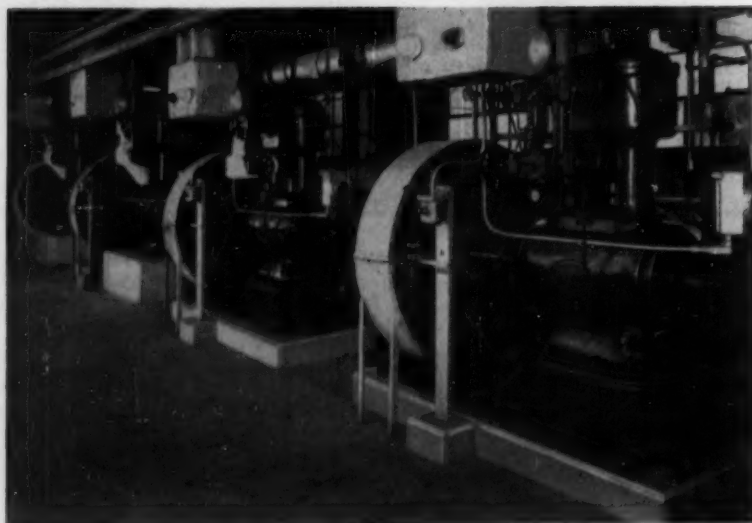
*Frick Valves are Preferred  
for many high-pressure  
services: get catalog now.*

*Below: Four of seven Frick  
compressors at Velsicol's  
Memphis plant.*

At the Memphis plant of this important manufacturer of insecticides, Frick equipment performs these vital functions:

1. condenses chlorine gas to liquid form
2. cools water for chilling caustic
3. chills alcohols to 40 degrees below zero in an organic process.

Whether you need a cooling system for air conditioning, food service, ice making, quick freezing, chemical processes or any other commercial or industrial purpose, you'll find Frick **ENGINEERED** refrigeration the ultimate answer. Let us serve you as we now serve the biggest concerns in the world.



### NAMES . . .

University of Missouri, have been assigned by Columbia-Southern Chemical Corp. as senior research chemists at the firm's chemical producing plant at Barberton, Ohio.

**Gilbert J. Stork**, professor of chemistry at Columbia University, has been named the recipient of the 1957 American Chemical Society Award in Pure Chemistry.



**Richard KixMiller**

On the retirement of Charles F. Beran, Richard W. KixMiller was appointed a director of Celanese Corp. of America.

KixMiller has been vice president in charge of the chemical division since 1955 and in the firm's employ since 1946.

During World War II naval service, he was assigned to the rubber reserve program as assistant manager of research and development in connection with the government's synthetic rubber program.

A Summit, N. J., resident, KixMiller graduated from Princeton University in 1942.

**Fred Fortess**, manager, dyeing and finishing laboratories, Celanese Corp. of America, received the sixth annual American Dyestuff Reporter award, at the Perkin Centennial sponsored by the American Assn. of Textile Chemists and Colorists.

**Jack V. Schurman** has been promoted to division head in the research and development department of Colgate-Palmolive Co., Jersey City, N. J.

**Rudy Hlawiczka** and **E. L. Whitt** have been promoted to



positions as process development department assistants for Carbide & Carbon.

**Wm. C. Soudriette** has been named plant manager for Cities Service Oil Co.'s East Chicago, Ind., refinery. He succeeds **L. E. Taylor**, who will be chief engineer of Petroleum Chemicals, Inc.

**Walter S. Svenson** has been appointed manager, process development, for California Oil Co. He succeeds **E. E. Gullekson**, who has been transferred to San Francisco.



**J. R. Stevens**

In recognition of his outstanding work as vice president and operating manager of the **J. T. Baker Chemical Co.**, President **M. W. Smith** has announced that **J. R. Stevens** has been elected executive vice president of the firm.

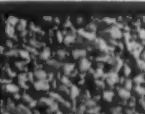
**Stevens** joined the firm in 1944 as director of research. Soon after he became technical director and, in 1951, was elected a vice president.

Both his undergraduate and graduate work were done at Massachusetts Institute of Technology.

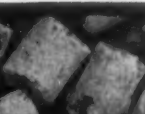
**Marcus G. Van Campen, Jr.**, pharmaceutical chemist, has joined **Cutter Laboratories**, Berkeley, Calif., as vice president for research. He had formerly been associate director of research for the **William S. Merrell Co.**, Cincinnati.

**Willem Lasthuysen** has been appointed to **Colgate-Palmolive's** perfumery and essential oils division of the research and development de-

HOW YOU  
BENEFIT  
WITH  
GIRDLER  
CATALYSTS



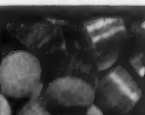
CUSTOM-DESIGN  
matches YOUR  
needs



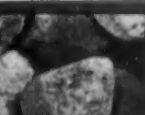
TECHNICAL SERVICE  
helps you save



QUALITY CONTROL  
assures uniformity



MODERN FACILITIES  
produce  
economically



GIRDLER RESEARCH  
gives you the best  
always

**Cuts consumption of  
nickel 50% with**

# GIRDLER G-12 CATALYST

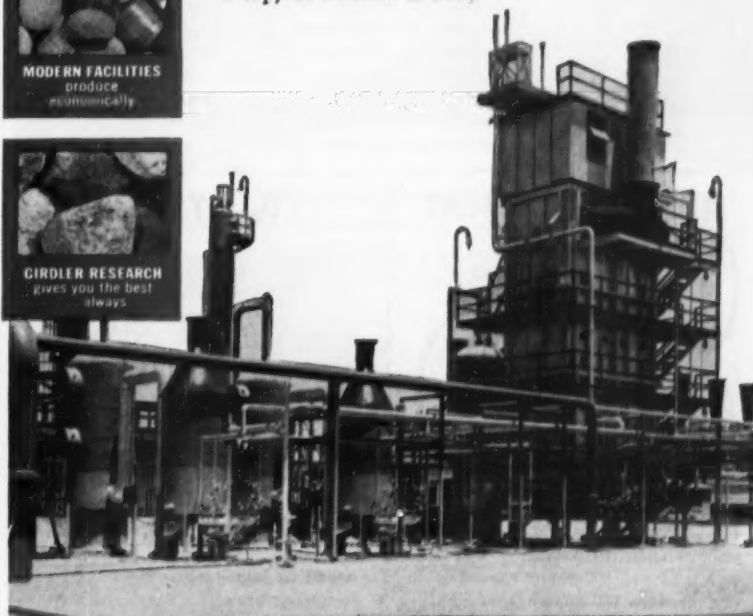
*at Celanese Plant,  
Bishop, Texas*

**APPLICATION:** Hydrogenation, employing a nickel type catalyst.

**TECHNICAL SERVICE:** Girdler engineers suggested installation of a supplementary G-12 catalyst case for further purification of the hydrogen.

**RESULTS:** Has cut consumption of expensive hydrogenation catalyst in half.

Technical personnel of the Girdler Catalyst Department will gladly assist you in your catalyst problems. Write for a copy of Bulletin G 260.



The **GIRDLER** Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY  
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GAS PROCESSES DIVISION: New York, San Francisco  
VOTATOR DIVISION: New York • Atlanta • Chicago • San Francisco  
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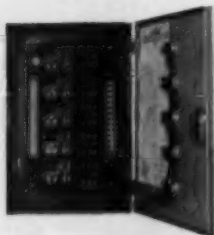
# FIRE! HOW TO DETECT AND EXTINGUISH IT IN SECONDS!

## HAND PORTABLES



Kidde CO<sub>2</sub> portables, either trigger-release type or squeeze-valve type models, are available in sizes from 2½ to 20-pound capacities. New Kidde Wet Chemical Extinguishers are available in 2½ gallon bronze or stainless steel models, including pressurized Water or Water-Anti-Freeze units (illustrated). Kidde Dry Chemical extinguishers are available in cartridge-operated models of 20 and 30 pounds capacity or pressurized models of 5 and 10 pounds capacity.

## ATMO DETECTING SYSTEMS

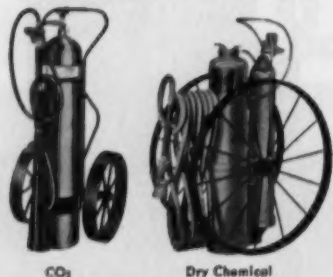


Kidde-Atmo is a wide-area automatic fire detecting and warning system which works on the principle of rate-of-temperature-rise. It is ideally suited for cases where life protection is of vital importance, or where quick, early detection of fire in valuable materials is essential.

The very first hot breath of fire triggers the system, and sounds the alarm. In addition, the system can also close doors, shut off fans or blowers — all automatically.

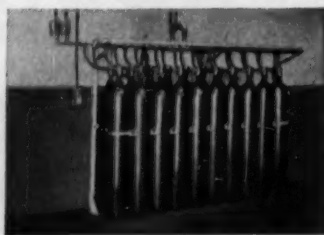
What's more, the Kidde-Atmo system operates independently of regular power sources, will still give protection even if outside power fails.

## MOBILE EQUIPMENT



For major fire hazards, get a mobile unit. Wheeled CO<sub>2</sub> units are available in 50, 75 and 100-pound capacities, in one cylinder. 150-pound Dry-Chemical unit has straight stream for long range ... fan pattern for wide coverage. Both units give expert results even with inexperienced operator.

## CO<sub>2</sub> SYSTEMS



New Kidde pressure-operated CO<sub>2</sub> extinguishing systems are individually designed to fully protect even the most dangerous hazards. Directional Valves afford protection to more than one hazard using the same bank of CO<sub>2</sub> cylinders.

## NAMES . . .

partment. He is the former chief chemist for Dodge and Olcott, Inc.

Fred R. Wilson, director of manufacture of du Pont's explosives department has been appointed director of sales for the department. He succeeds George Loving, who became assistant general manager of the photo products department in October.



Herman Schneiderman

American Latex Products Corp., Hawthorne, Calif., has appointed Dr. Herman Schneiderman as its technical director.

Schneiderman has had wide experience in chemical engineering applications in industry. Formerly, he was chief of the structural plastics group at Aerojet-General Corp., Azusa, Calif., senior research engineer at the Jet Propulsion Lab, California Institute of Technology, and chief of the biochemistry division of the atomic energy project at the UCLA School of Medicine.

Mart J. Hartig has been transferred to the du Pont plant at Belle, W. Va. He is superintendent of the laboratory group.

Lewis R. Drake, accountability and production control superintendent at the AEC plant operated by Dow Chemical at Rocky Flats, Colo., has returned to Midland to take over a new position as assistant director of the nuclear and basic research labs.

R. M. Burns, senior scientific advisor to Stanford Research Institute, Palo Alto, Calif.,

# Kidde



Walter Kidde & Company, Inc.  
1228 Main Street, Belleville 9, N. J.  
Walter Kidde & Company of Canada Ltd.,  
Montreal — Toronto



has been awarded the Acheson Medal of the Electrochemical Society for 1956—largely for his work on the corrosion of metals.

**William F. Christie** and **James M. Martin** have been appointed sales representatives for Escambia Chemical's plastics division in the Middle Atlantic and New England states, respectively.

**John I. Crabtree** of Kodak Research Laboratories has been awarded the highest award of the Photographic Society of America—The Progress Medal—"for his outstanding contributions to photographic chemistry and processing methods."



**William C. Nicoll**

National Chemical & Mfg. Co., Chicago, has acquired the G. J. Liebich Co. as a new division, and William C. Nicoll has been appointed technical director.

Formerly executive vice president and general manager of R-Mor Paint Co., Chicago, Nicoll has served as technical director for the Illinois Paint Works.

He is a graduate chemical engineer from Drexel Institute, in Philadelphia.

**Robert D. Flori** has been elected president of the new combination of Flori Pipe Co., St. Louis, and Houston Pipe & Steel Co., Houston. Sparks Withington Co. is the parent firm.

**James F. Adams** and **C. William Roos**, project leaders in the chemical engineering section of Monsanto Chemical's research department, have been promoted to group leaders in

## How To Save Money On



**OUTSIDE  
RED HOUSE**

&



**BARN  
PAINT**

**FORMULATIONS**



By proper selection of Pure Red Iron Oxide pigments and extenders, pigment-volume ratio can be increased, fading and color losses retarded, and general durability improved.

Exposure tests on our fences as long as 7 years clearly indicate the improvement in performance which can be obtained through revised compositions. You may have reviewed these test panels at the recent Paint Industries Show.

Your Williams representative will be glad to talk with you about house and barn paint formulations. Why not see him?

**WILLIAMS**  
COLORS & PIGMENTS

C. K. WILLIAMS & CO. Easton, Pa. • East St. Louis, Ill. • Emeryville, Cal.





*New...and in stock!*

## Ampco Centrifugal Pumps In 316 Stainless

*Hydraulic range  
includes capacities  
to 600 gpm.,  
heads to 160 feet.*

*Pedestal assemblies  
available for  
base-mounted coupling  
connections.*

*Close-coupled  
connections fit NEMA  
standard pump motors.*

New, high-speed pumps for handling clear liquids and fine slurries not corrosive to GR. 316 SS.

Although stock items, these pumps include features which, until now, have been available only on special order for custom-built models:

1. *Correct-design closed impellers* — for greater efficiency, longer life.
2. *Wear rings* — to save the casing, prevent expensive repairs, reduce down-time.
3. *Shaft sleeves* — to give greater operating economy, eliminate worn shafts, cut maintenance costs.

Ask your Ampco Pump Distributor to show you how these off-the-shelf pumps are easily adapted to the particular requirements of your specific application. Write for his name—and Bulletin P-3C.

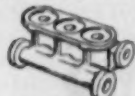
### AMPCO METAL, INC.

Dept. 12-CE Milwaukee 46, Wis. • West Coast Plant: Burbank, Calif.



**THE METAL WITHOUT AN EQUAL**

AMPCO — ONE-SOURCE SERVICE FROM RAW MATERIAL TO FINISHED PRODUCT



SAND CASTINGS



CAST FLANGES



FORGINGS



CENTRIFUGAL CASTINGS



EXTRUSIONS



CAST PIPE FITTINGS



FABRICATIONS



SHEET AND PLATE



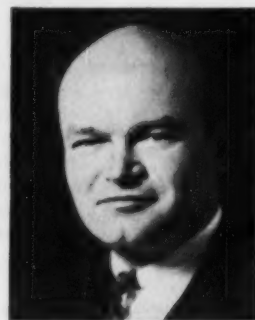
MACHINED PARTS

PR-33

### NAMES . . .

charge of engineering and economic evaluations and engineering research, respectively.

Lee M. Berlin has been named manager of a new film products group at Minnesota Mining & Mfg. Co., St. Paul, Minn.



O. V. Tracy

Newest vice president of Esso Standard Oil Co. is O. V. Tracy—member of the firm's board of directors.

Tracy has been a member of the company's executive committee since May 1956, with board-level responsibility for both the manufacturing and chemical products departments.

He served as general manager of chemical products from 1949 until last January, when he gave up that post to give full time to his duties as a director.

Since 1930, when he joined Esso Standard, Tracy has been associated with the development of synthetic rubbers, alcohols and other chemical products from petroleum.

Walter R. Bush has been appointed vice president in charge of engineering and a member of the management committee of Fenwal, Inc., Ashland, Mass.

C. V. Dille has been made plant superintendent of Firestone Tire & Rubber Co., Lake Charles, La. He'll have charge of the production, technical maintenance and engineering departments.

W. A. Wilson and B. J. Ferkes have been named plant managers of Firestone Tire &



Rubber's Orange, Tex., and Noblesville, Ind., plants, respectively.

**Peter A. Castel** has been named director of new products development of the Foster Grant Co., plastics molding firm.

**Harold L. Gross** has been named vice president and general manager of General Adhesives Co.—new chemical division of General Shoe Co., Nashville, Tenn.



**Burton Coplan**

The chemical development department, General Electric Co., has appointed **Burton V. Coplan** to the post of silicon project supervisor.

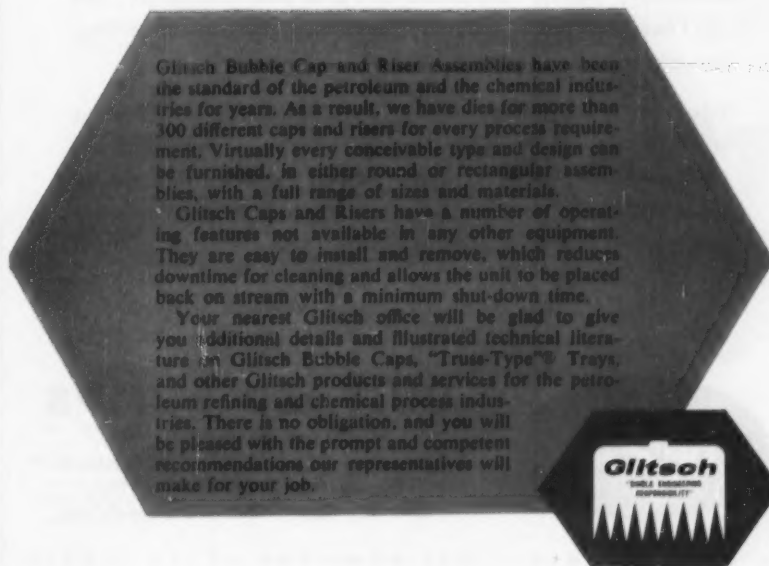
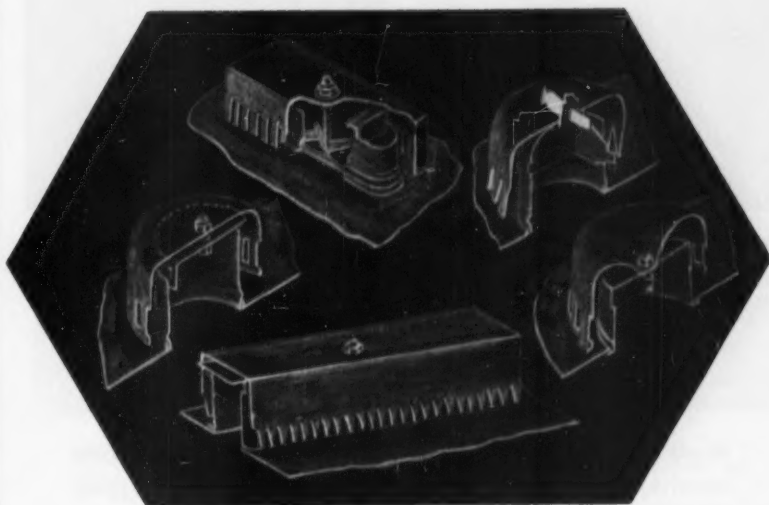
He joined GE's Knolls Atomic Power Laboratory in Schenectady in 1948 and served there as a supervisor in the chemical engineering unit and as assistant section manager of chemistry.

Before coming to General Electric, Coplan had worked as a process design engineer for M. W. Kellogg. A native of Troy, N. Y., he did his undergraduate work at Rensselaer.

**Ben Chizeck** and **Onorio Colucci** have joined the engineering staff of Pittsburgh Coke & Chemical's chemical divisions.

**James R. Britt** has been appointed manager of the chemical plants division of Procon, Inc., Des Plaines, Ill.

**Ralph A. Purcelli**, former assistant general manager of Rockwell Mfg. Co.'s gas regulator plant, Norwalk, Ohio, has been named general man-





# this "Buffalo" pump moves your acids on rubber



"Buffalo" Rubber-Lined

Pump with upper half of casing removed.

## -REDUCING COSTLY DOWN-TIME -ELIMINATING EXCESSIVE REPLACEMENTS

If you are pumping highly corrosive liquids, or liquids containing abrasive solids, you may be paying the high price of short pump life. However, where such severe service destroys ordinary pumps in a hurry, "Buffalo" has the answer: *what acids can't touch, they can't hurt.* And in this "Buffalo" Pump, the liquid contacts nothing but rubber, vulcanized to the impeller and passages.

Pump life is multiplied many times and the cost of rubber lining is negligible when compared to the savings in down-time and replacements. Have us mail you Bulletin 982 — see this and the other "Q" Factor\* features that save you money and troubles when you specify "Buffalo" Chemical Pumps.

*\*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*



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A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

## NAMES . . .

ager at the firm's new plant in Statesboro, Ga.

Edward Wenk, Jr., has been appointed chairman of the department of engineering mechanics, Southwest Research Institute.



Paul J. Flory

Eminent scientist at Cornell University, Dr. Paul J. Flory has been chosen to be Mellon Institute's executive director of research.

Flory is professor of chemistry and acting chairman of the department of chemistry at Cornell. Previously, he had spent 12 years in industry, in chemical and allied fields. Some years back, he did research for Standard Oil Development and, later, for Goodyear Tire & Rubber Co. From 1950 until the present, he has been engaged in consulting work for du Pont.

A graduate of Manchester (Ind.) College, Flory later did graduate work at Ohio State College during the early thirties.

R. W. Daniels and P. G. Connell, Jr., have been appointed managers of American Cyanamid's intermediates and rubber chemicals departments, respectively.

Professor George W. Preckshot, of the University of Minnesota, and research engineer Jay Nouri have won the 1956 Fatty Acid Award of \$500 for various research data, including the solubilities and phase diagrams for oleic, palmitic and stearic acids.

Norman A. Matthews, formerly assistant chief metallurgist with American Brake Shoe



Co., has joined GE's metallurgical products department, Detroit, as research engineer.

**Andrew Jenike**, materials handling consultant, is conducting a research project in the flow of bulk solids at the Utah Eng. Station, University of Utah.

**Fred W. Evans** has been appointed assistant to the president of Surpass Petrochemicals Ltd., Scarborough, Ont.

**William C. Greenleaf** has been named manager of metals development for U. S. Industrial Chemicals Co.

**E. J. Mills, Jr.**, has been assigned to a new staff position at Carbide & Carbon's S. Charleston, W. Va., plant, handling special technical assignments as well as the recruitment of technical personnel.

**John G. Polcari**, **William Balmain** and **Frank Schroder** are new members of Union Carbide & Carbon's silicone division staff.

**Reese H. Taylor**, board chairman of Union Oil Co., Calif., has been elected a director of Westinghouse Electric Corp. He succeeds **Marvin W. Smith**, who resigned recently.

**Harold C. Wagner** and **Thorald Alexander** have been named technical director and chief engineer, respectively, for Zirconium Corp. of America.

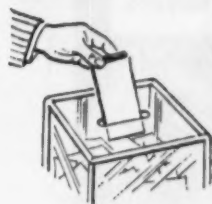
#### OBITUARIES

**Norton P. Smith**, president of Klix Chemical Co., South San Francisco, died September 24 at the age of 51.

**James Harrison Ratliff**, 77, vice president of Humphreys Phosphate Co., Denver, died of a heart attack at his home in Vernal, Utah, on September 20.

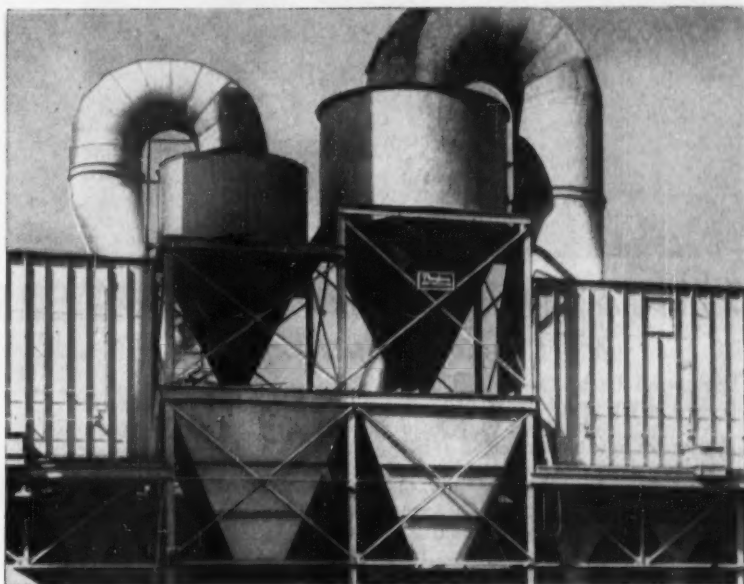
**Camille Dreyfus**, co-founder (with his brother Henri) of Celanese Corp. of America, died September 27.

## Henry Chanin Corp. cast its ballot for



# Pangborn Dust Control

... and voted itself over \$10,000 a year



The Henry Chanin Corp., East Point, Ga., is a processor of textile waste. To control the great quantities of dust released by the operations at this plant, the firm uses four Pangborn Dust Collectors.

Today Pangborn Dust Control has almost doubled production at Henry

Chanin by eliminating daily downtime that had been required for machine repairs.

Working conditions and quality of product are both improved. And, thanks to Pangborn, maintenance and labor costs have been lowered by over \$10,000 a year!

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*How  
do You  
Vote?*

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Please send me more information on Pangborn Dust Control immediately.

If you're interested in efficient, profitable plant operation, cast this "ballot" for additional information on Pangborn Dust Control. Send to Pangborn Corp., 2600 Pangborn Blvd., Hagerstown, Md.

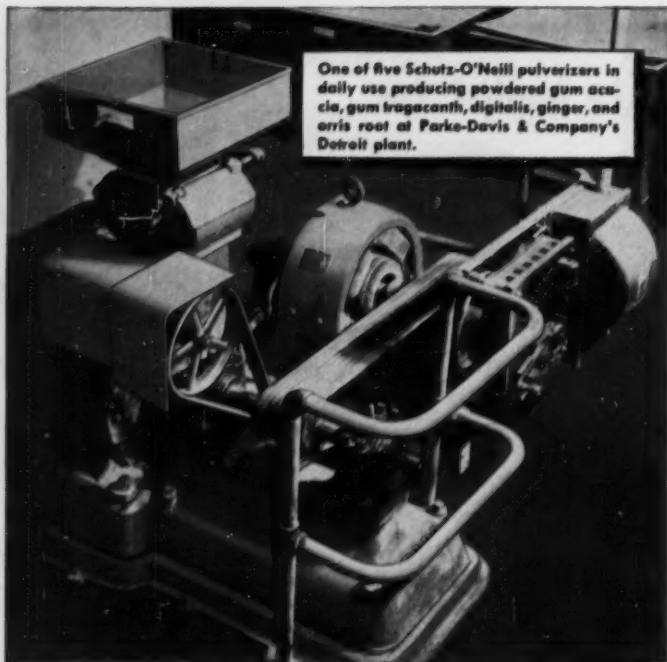
Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_





One of five Schutz-O'Neill pulverizers in daily use producing powdered gum acacia, gum tragacanth, digitalis, ginger, and orris root at Parke-Davis & Company's Detroit plant.

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### A 50-YEAR TRADITION

The name Parke-Davis & Company is known worldwide as a leading pharmaceutical manufacturer. For over fifty years Schutz-O'Neill pulverizers have played a dominant part in this well earned reputation in the production of highest quality products that meet the most rigid standards.

Manufacturers of food, chemical, drug and mineral products have depended on Schutz-O'Neill pulverizers for over 65 years. In all parts of the world Schutz-O'Neill pulverizers are in daily operation preparing materials ranging from microfine powdered sugar in the food industries, to borax in the mineral industries.

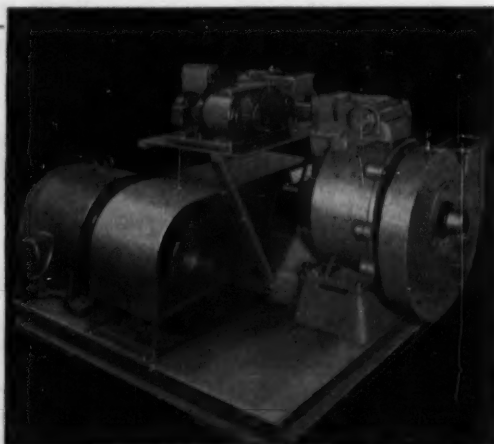
Versatility for production of medium-coarse, fine and microfine powders have made them the choice for milling superior powders from such materials as specialty grain fractions, cocoa powder, aspirin, saccharin, ultrafine diatomaceous earth, limestones and phosphates, urea melamine and phenolic plastic moulding powders, and herbs, barks, roots and seeds of all types.

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AIR CLASSIFIERS  
SIFTERS  
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## Letters:



### Pro: Alert Design

Sir:

I agree with most of the ideas expressed by the authors of the article, "Cut Repair Time and Costs With Alert Design" (Oct. 1956, pp. 190-195).

The real key is in the concluding paragraph. In trying to effect sound design which will recognize all the many maintenance and safety points, we have found that few design engineers have the necessary background in operation and maintenance to be aware of all these considerations and give them proper weight in their thinking and planning.

For best results, we have found that preliminary design drawings should be reviewed critically by engineers in the operating and maintenance staffs of the plant concerned. These men can always contribute many practical suggestions, because they think along quite different lines than the design engineers.

The real problem, as a rule, is to get plant engineers to take the time to make such reviews. We have found that by holding a "conference," with the design engineers explaining each drawing, we can get excellent re-



## Pro & Con

C. H. CHILTON

sponse from maintenance and operations people. Their ideas can then be incorporated in the final design drawings, and at not too great a cost.

Actually, we know that the cost of this kind of meeting is repaid many times over by the valuable suggestions contributed. Group thinking can be quite productive, and one suggestion often stimulates three or four others. Likewise, since these meetings serve to acquaint the plant people with the new facilities they actually can be considered as valuable advance training. Our firm follows this practice, and we can testify to the quality of the results obtained.

JACKSON D. LEONARD  
Brown, Blauvelt & Leonard  
New York, N. Y.

### Pro: Wolverine State

Sir:

In glancing through your recent Inventory issue I noticed one error about Monsanto's facilities. Somehow the mistake got started some months ago and has been repeated several times in various places.

The facilities for our plastics division and for Shawinigan Resins are located in Trenton, Mich., not N. J. The plant is well under way, and the on-stream date of late 1956 still stands. It is located immediately adjacent to our phosphate salts facility in Trenton.

ALLAN E. SETTLE  
Monsanto Chemical Co.  
St. Louis, Mo.

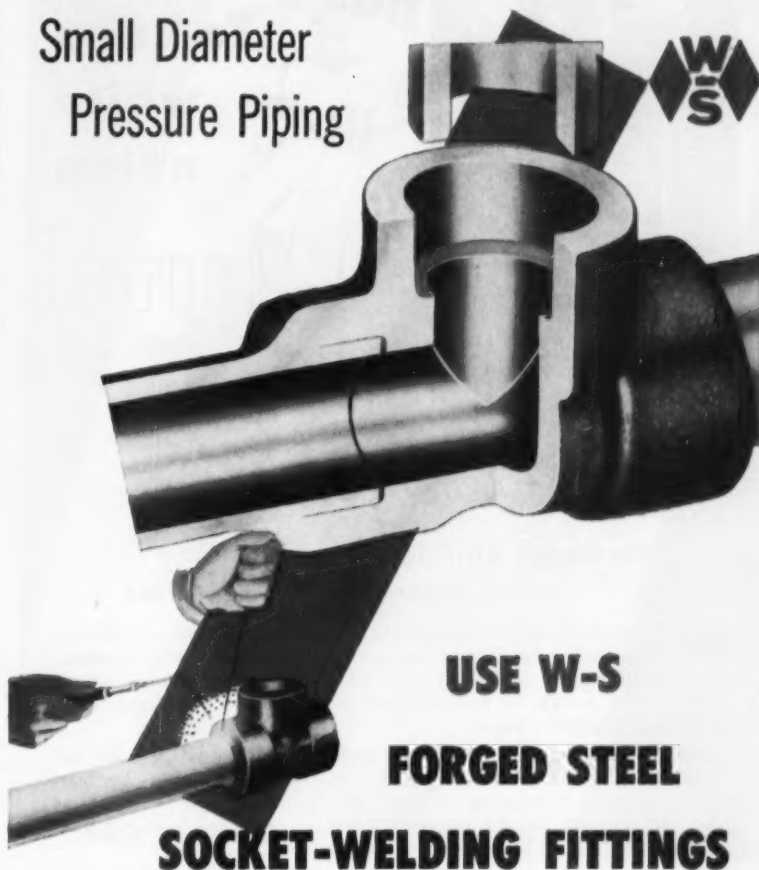
### How New Is "New"?

Sir:

On p. 126 of your September issue you refer to a "new use for gilsonite as underground pipe insulation."

This use of gilsonite was first discovered by American Gilsonite Co. more than five years ago. For three years now this use has been intensively advertised, publicized and sold under the registered tradename of Gilsul-

## Here's the **EASY WAY TO WELD** Small Diameter Pressure Piping



**USE W-S**

**FORGED STEEL**

**SOCKET-WELDING FITTINGS**

In addition to providing high strength and toughness, W-S Forged Steel Socket-Welding Fittings are also easy to install. Deep sockets support and align the pipe for welding... eliminating the need for tack welding or special fixtures. No back-up ring is needed either. The fillet-weld is completely outside the pipe. Welding icicles just can't form inside the pipe. The result is a clean, tight welded joint that will readily resist high pressures and the stresses of shock and vibration. What's more, installation costs are lower.

W-S Socket-Welding Fittings are available in sizes  $\frac{1}{8}$ " to 4" for schedule 40, 80, 160 and double-extra heavy pipe in carbon steel, stainless steels and alloy steels.

For complete information on the installation and operation advantages of W-S Forged Steel Socket-Welding Fittings, send today for Bulletin A-3-56.



**W-S FITTINGS DIVISION**

**H.K.P. H. K. PORTER COMPANY, INC.**

Roselle, New Jersey





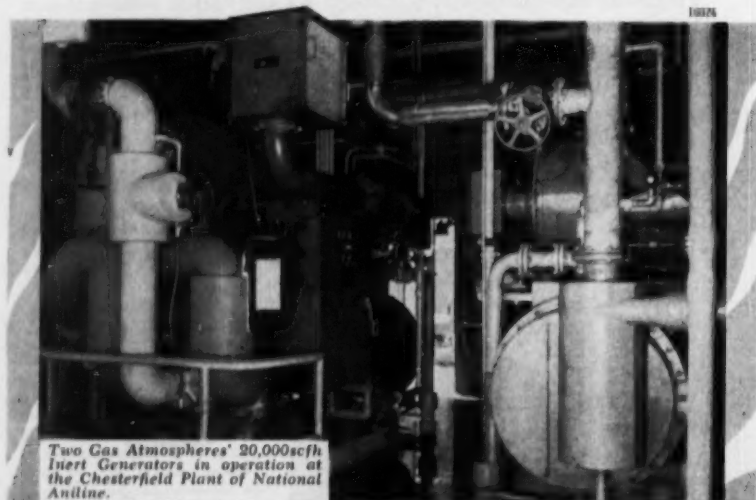
Gas Atmospheres' 6000 scfh Inert Generator with refrigerant dryer, compressor and dessicant dryer designed and built for National Aniline.

### National Aniline relies on Gas Atmosphere Generators

When the woman buyer wants something white—she means "whiter." This desire for whiter whites has chemists, textile people, synthetic fiber manufacturers and soap and detergent makers, among others, in a constant search for methods and processes that will enable them to achieve brighter whites.

National Aniline Division of Allied Chemical and Dye Corporation has developed a way for manufacturing "extra white" nylon. A big part of their method is keeping oxygen away from the nylon as long as possible. They do this by blanketing process vats and purging lines with an inert gas of their own manufacture.

To get the finest gas generation possible National Aniline selected a Gas Atmospheres' Inert generation. Its performance has resulted in the purchase of two additional Gas Atmospheres' units that give National Aniline all the inert gas they need at remarkably low cost.



Two Gas Atmospheres' 20,000scfh Inert Generators in operation at the Chesterfield Plant of National Aniline.

**gas Atmospheres, inc**

equipment for producing industrial gases  
20011 WEST LAKE ROAD CLEVELAND 16, OHIO

### PRO & CON . . .

ate. Furthermore, this use of gilsonite is patented.

In the interests of accuracy it should be reported that use of gilsonite for underground pipe insulation is new for G. S. Ziegler & Co. but by no means new for industry.

MELVIN ELLIOTT  
Fred Wittner Advertising  
New York, N. Y.

► According to Ziegler, underground pipe insulation is "another new use recently found" for gilsonite.—Ed.

### Ch. E.'s vs. Bricklayers—I

Sir:

I would like to congratulate you and Prof. Stewart on the article, "Does Chemical Engineering Pay?" (Sept. 1956, pp. 192-194).

The comparison between bricklayers and chemical engineers is particularly apropos. I have found this to be a common subject of discussion among those in the rank and file of the profession who are capable of a discerning analysis of their position in today's economic scene.

During the past year the facts pertaining to the manpower situation have been increasingly beclouded by propaganda from such sources as the Manufacturing Chemists' Association and various individuals who imply that they represent the chemical and engineering professions. Strangely enough, our own technical societies, such as the American Institute of Chemical Engineers and the American Chemical Society, have allowed their meetings and publications to be used as sounding boards by these same people in their intensive, self-serving efforts to increase the supply of technical manpower. These efforts may or may not be in the interests of the majority of the societies' own members.

We have also heard this same class of individuals expound on the merits of free enterprise, decreased government controls, individual initiative, etc. We are very much amused by their failure to mention that the "law of supply and demand" (to use one of their favorite clichés) is also applicable to the supply of tech-



nical labor, and that perhaps the restoration of the income differentials of the 1920's and early '30's pointed up in Prof. Stewart's article would cure any "shortage" within a few years.

Many of us who have children in high school are faced with the unpleasant task of directing the interests of our own children away from our profession to which, because of the intellectual atmosphere of a home where the parent is employed in a professional career, their interests have naturally turned.

Again may I congratulate you and Prof. Stewart for your courage in publishing this factual article in the present atmosphere of prejudice, emotion and propaganda.

Should you wish to publish this letter I would prefer to remain anonymous.

NAME WITHHELD

Deerfield, Ill.

► Prof. Stewart's article has provoked a great deal of comment from and among our readers. See last month's *Pro & Con*, pp. 402-405, and the following analysis of the article by our own *Economics Editor*.—Ed.

## Ch. E.'s vs. Bricklayers—II

### INTER-OFFICE MEMORANDUM

To: John Callahan, *CE* Editorial  
From: Bill Chartener, Dept. of Economics

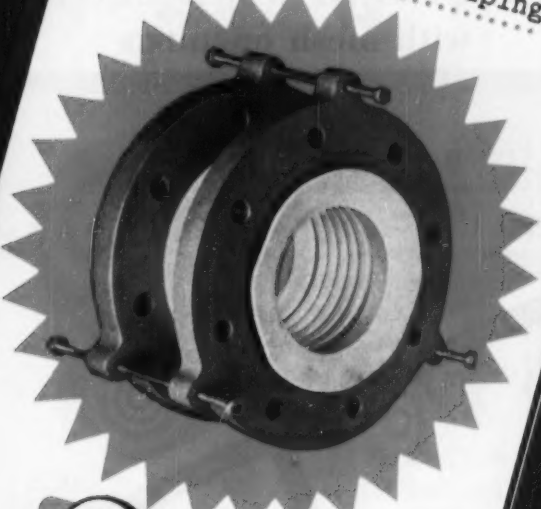
We share Prof. Stewart's conviction that the financial status and prospects of engineers must be elevated if their profession is to attract sufficient recruits for the needs of the economy.

However, the author leaves himself open to several criticisms—or, at least, questions—regarding his selection and interpretation of evidence.

1. Although the author draws conclusions about today's conditions, his latest data on engineers' salaries apply to 1951. It is true that there were alarms about an impending shortage of engineers in 1951, but the real pinch did not begin until later. Prof. Stewart probably will have to revise his curves considerably when 1955 or 1956 data are available.

2. The cutoff point of Prof. Stewart's plotted data is 24

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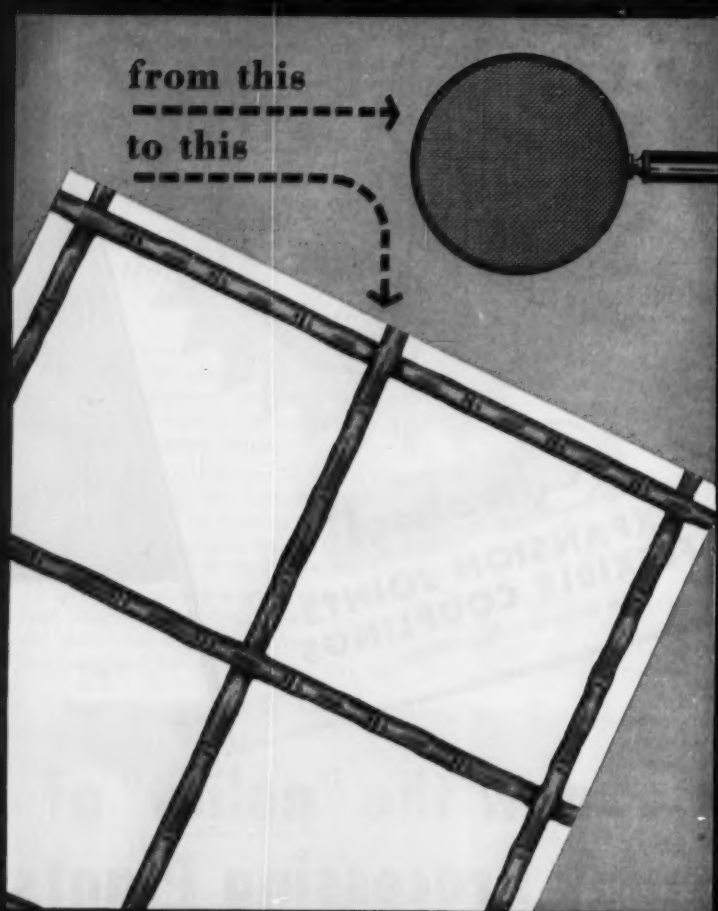
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## PRO & CON . . .

years after graduation. Although, as in most professions, the engineer's period of high earning power is after age 45, Prof. Stewart's figures exclude this period. His data make it appear that "median" chemical engineers have a very low ceiling salary.

3. Selection of skilled craftsmen in the building trades for comparative purposes is questionable on several grounds. In the first place, on the basis of weekly earnings these are the elite of skilled workers.

Secondly, most of these workers do not enjoy anything like the 50-week year the author attributes to them. Last year—an exceptionally good construction year—only 46% of all construction workers had jobs lasting as long as 50 weeks.

Skilled building craftsmen themselves have been scarce and have enjoyed a seller's market in recent years. The building trades, however, have been much more adept at exploiting their market position than engineers, who have been unable to emulate either the International Brotherhood of Electrical Workers or the American Medical Association.

I would suggest, too, that an inexperienced B.S. chemical engineer is probably not worth as much to his employer as a skilled construction worker.

4. Prof. Stewart's payout-time approach is scarcely appropriate. This approach would make our Cadillac-driving medical friends seem the most exploited souls on earth. If the payout-time approach were followed to its logical conclusion, the best advice to give young men, I fear, would be to take a job in the coal mines at as early an age as the law allows.

There must be better—and, I hope, simpler—ways of proving that chemical engineers deserve greater recognition.

► Prof. Stewart again rises in defense in the letter which follows.  
—Ed.

**Ch. E.'s vs. Bricklayers—III**  
Sir:

Regarding the omission of salary data later than 1951, see my comments in an earlier letter



(Nov. 1956, pp. 404-405). More recent data change the extrapolated figures somewhat but do not change the basic conclusions of the article.

Mr. Chartener's comments regarding increased earning power after age 45 are certainly true. (Table I of my original manuscript gave these figures; you chose not to publish this table.) Also equally true is that we do not yet know what the classes of 1943 and later will be earning from age 45 on.

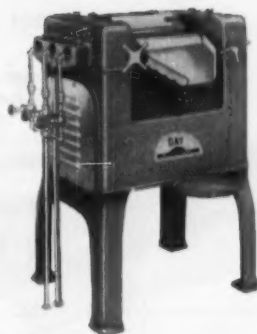
As regards continuity of employment in the building trades, I tried to show in my Tables IV and V (which you also chose not to publish) that the construction trades earnings might be used as a *measure* of earnings in other trades—others with better job continuity. In this connection, here's what a New York consulting engineer has written me:

"You're right about continuity of employment. The engineer is considered exactly like the draftsman or any other construction employee when times are slow. When conditions are booming, he is asked to be 'patient' and is told that salary 'isn't everything'."

Regarding the roles of labor unions and professional societies, few people will quarrel with Mr. Chartener's implication that the AMA has raised the economic status of physicians.

So far, at least, AICHE and ACS are not making (nor are others making for them) similar claims. One reason given for this situation is that such activity would violate their charters. I wonder if the status of the officers and directors is significant in this respect. In the AMA these men are in private practice and have the same problems as the bulk of the membership, also in private practice. In ACS and AICHE, with some notable exceptions, the officers and directors are business executives who face the same problems as do the majority of the members, but from the other side of the table.

As to payout time: Regardless of the long-range potentialities, most people consider present income quite important, too.

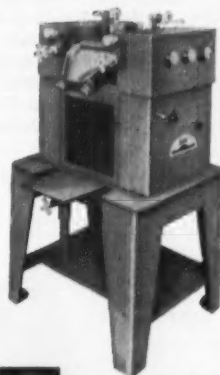


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saves time because you get the answers quickly and accurately.

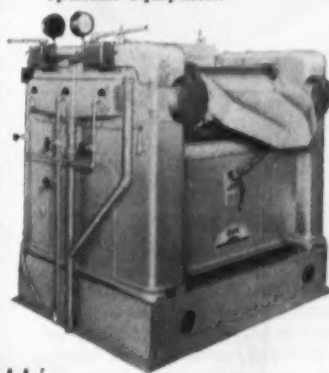
Features include:

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- Available in 10 x 22 and 14 x 30 sizes
- All standard production mills are readily converted to either fixed or floating roll operation
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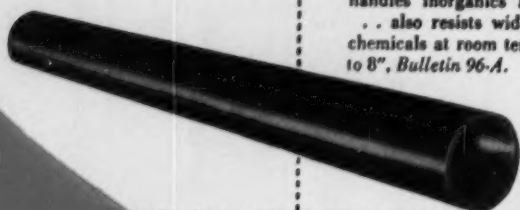
Only the  
Right piping  
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"GOOD RUN"

For profitable runs you must keep equipment "on stream" full time with no corrosion shut-downs. Protect your profits with Ace piping, pumps, valves, and tanks. Many rubber and plastic materials . . . backed by a century of chemical experience. Get facts today from American Hard Rubber Company.

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##### ACE TEMPRON

Heat-resistant nitrile hard rubber pipe handles inorganics at 250-275 deg. F. . . also resists wide range of organic chemicals at room temperature. Sizes 1" to 8". Bulletin 96-A.



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for pumping acids



Jabco neoprene-impeller pump made of Ace hard rubber outlasts, out-pumps anything in its pressure, size and price class. Capacity from 15 gpm. at 22 ft. head to 5 gpm. at 72 ft. head. Bulletin 97-A.

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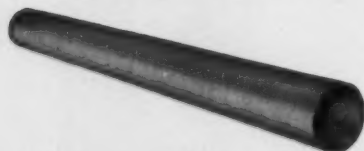


#### ACE Darling Swing Check Valve . . .

lined with Ace hard rubber for the best in corrosion resistance. Large, straight-through flow areas. Sensitive to slight pressure differential. Non-slamming. Sizes 2" to 24". Bulletin CE-52.

#### TOUGH ACE-ITE PLASTIC PIPE

General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170 deg. F. . . except few strong acids and organic solvents. Tough, odorless, tasteless. Rigid pipe 1/2" to 6". Bulletin 80.



**ACE** processing equipment of rubber and plastics

**AMERICAN HARD RUBBER COMPANY**  
93 WORTH STREET • NEW YORK 13, N. Y.

#### PRO & CON . . .

For this reason, "pie in the sky, bye and bye" has difficulty in competing with the "bird in the hand."

PAUL B. STEWART

University of California  
Berkeley, Calif.

► Two of the preceding three letters are critical of AICHE and ACS for not taking a more active part in elevating the economic status of the chemical engineering profession. We feel that such criticism is not entirely justified.

Both organizations have cooperated in surveys of salaries of their members and have opened up the pages of their publications for dissemination of the data so obtained. Such data, indeed, form the statistical backbone of arguments such as those advanced by Prof. Stewart.

A few months ago AICHE published an official statement adopted by its officers and directors on "Professional Standards." This statement includes a section on "Financial Recognition," part of which reads as follows: "Keeping a fair and reasonable pay differential between the engineer and the nonprofessional employee."

Also, AICHE's Code of Ethics states, "Members shall uphold the principle that unreasonably low charges for professional work tend toward inferior and unreliable work."

On the other hand, AICHE admits in its pamphlet, "Know Your Institute," that its influence in this sphere needs to be strengthened: "Chemical engineers do not enjoy so high a professional prestige as do members of some of the other professions . . . Wishing for professional prestige will not earn it, and waiting for some organization to confer it is equally futile . . . AICHE consolidates individual efforts toward recognition. . . . Joining the AICHE will not guarantee a promotion or a salary increase." —Ed.

#### Simpler Contacting Device

Sir:

Congratulations to Dr. Raymond Vener for a comprehensive and informative report on Liquid-Gas Contacting (Aug. 1956, pp. 175-206).

Dr. Vener has, however, overlooked one mechanical method of gas-liquid contacting which we have found to be simple and very effective for some applications.

We have used two centrifugal pumps and a holding tank. Liquid is circulated to and from



the holding tank through the two pumps in series. Gas is introduced into the circulating liquid between the pumps, mixes with the liquid in the second pump and separates in the holding vessel. For a gas-liquid volume ratio of 1.0 or less and with a high-speed impeller in the second pump, a very fine dispersion of gas in liquid is possible.

This system offers a number of additional advantages. The contact time can be adjusted by varying the length and size of the discharge line from pumps to holding tank. Heating or cooling can be provided on this discharge line so that sensitive temperature control is obtained close to the point of gas-liquid mixing, and the forced circulation results in a smaller heat-exchange area than would be required for a jacketed mixing vessel.

Also important is the easy accessibility of the mixing mechanism for maintenance or replacement.

GEORGE E. HADDELAND  
Shawinigan Chemicals Ltd.  
Shawinigan Falls, Que.

#### Pro: Wider Useful Range

Sir:

Your description of our new indicating temperature controller (Oct. 1956, p. 256) erred in one rather important point. This controller is automatically case-compensated for any ambient temperature between 50 and 150 F., not 50 and 100 F.

JOHN M. RUFFNER  
Fenwal Inc.  
Chicago, Ill.

#### Pro: More Helpful Articles

Sir:

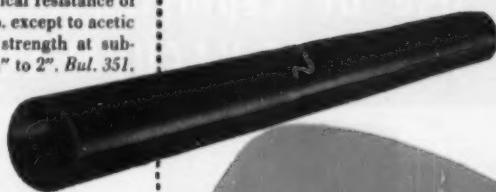
I have just been studying the article, "Linear Programming, How Does It Work?" in your August issue (pp. 215-216). I am sorry to say that I now find myself about as ignorant as before I started.

Linear programming is an interesting and valuable subject. I hope we will have more articles in the future, and that they will be more helpful than either of the two in the August issue.

MURRAY UNDERWOOD  
Monsanto Chemical Co.  
Springfield, Mass.

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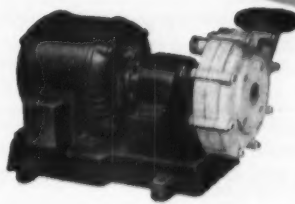
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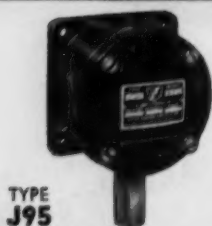
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## Meet Your



**Nevin K. Hiester**

TOOLS FOR TOMORROW—  
HIGH TEMPERATURES. PAGE  
173.

Nevin Hiester is not a newcomer to *Chemical Engineering* readers, who will recall him as the senior author of the outstanding Report on Ion Exchange in our October 1954 issue. He is manager of the Chemical and Metallurgical Engineering Section of Stanford Research Institute, Menlo Park, Calif., and with his co-authors of this three-part report, organized the program of the symposium which is high-lighted here. High temperature research, including work with solar furnaces, is one of his important responsibilities.

Hiester was introduced to *CE* readers in our "Man of the Month" department in April 1955, in an article which signaled his having been chosen as the San Francisco Bay Area's "Outstanding Young Chemical Engineer" of 1955. But to summarize it again, native-Hoosier Hiester took his BS in ChE at the University of Washington in 1941, was commissioned and served first in the Coast Artillery, then in the U. S. Air Force, leaving in 1945 as a major.

Returning to the university of Washington he took his MS in ChE in 1947, followed two years later by the PhD degree in ChE at the University of California, Berkeley. He joined Stanford Research Institute the same year, dealing with manifold problems in ion exchange (his main specialty), high temperatures, fluid flow and heat transfer, mineral technology, and chemical economics.



## Authors...

Since 1952 Hiester has lectured to graduate students on adsorption and ion exchange at Stanford University.

Hiester's activities are numerous. He is a registered professional engineer in California, holds memberships in various professional societies such as AIChE, ACS and American Rocket Society, as well as in Sigma Xi, Tau Beta Pi and Phi Lambda Upsilon. At present he is chairman of the Northern California section of AIChE.



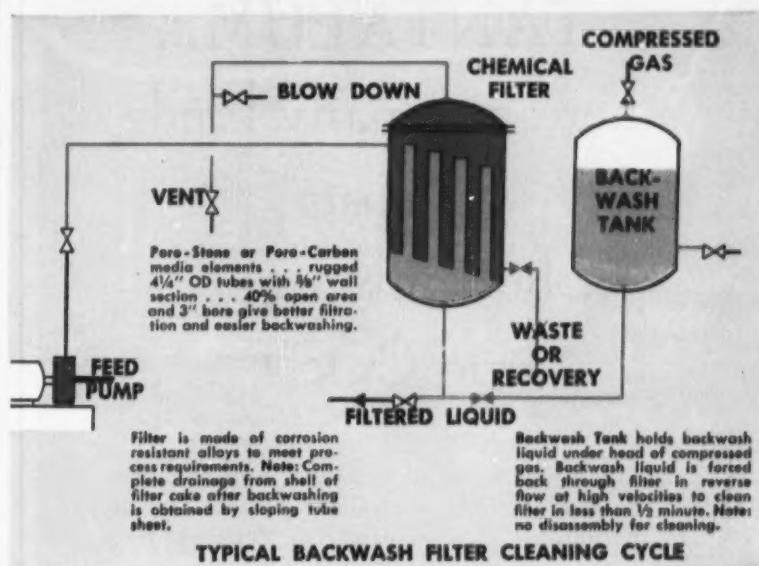
Alan W. Searcy

TOOLS FOR TOMORROW—  
HIGH TEMPERATURES, PAGE  
173.

Alan Searcy's college education was interspersed with military service, during which time he underwent a period of training in the Army Specialized Training Corps at Texas A and M, followed by Signal Corps service in Seattle and Alaska. He received his AB in chemistry at Pomona College in 1946, then entered the University of California at Berkeley where, as a graduate student in chemistry, he conducted his thesis research under co-author Leo Brewer.

Searcy was a member of the chemistry department at Purdue from 1949 to 1954, and received his PhD in 1950. Then in 1954 he returned to the University of California as an associate professor of ceramic engineering, which is his present position. He has written extensively on high temperature chemistry and chemical thermodynamics, his major research interests at present be-

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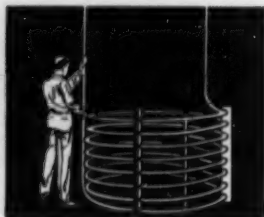
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## AUTHORS . . .

ing in the structures and thermodynamic properties of high melting silicide and germanide compounds, in the compositions and stabilities of the vapors from high melting carbides and oxides, and in the thermodynamics and kinetics of vaporization processes.

Searcy's memberships include Phi Beta Kappa, Sigma Xi and Phi Lambda Upsilon, as well as the American Chemical and Ceramic Societies.



**Leo Brewer**

**TOOLS FOR TOMORROW—HIGH TEMPERATURES, PAGE 173.**

Leo Brewer is professor of chemistry at the University of California, at Berkeley. He took his BS at Cal Tech in 1940, receiving his PhD at Berkeley in 1943. During the War he was a chemist with the Manhattan District at Berkeley, doing research on high temperature properties of compounds, and preparing critical compilations of thermodynamic data. Then in 1946 he joined the teaching staff at Berkeley, in the chemistry department, and is now a full professor.

Brewer's long-time interest in high temperatures has led to development of new refractories and to work on their properties. He is concerned also with the identification of important gaseous species in high temperature systems, and the determination of thermodynamic data such as molecular heats of dissociation. Many of his former PhD students are now carrying on similar work in high temperatures at laboratories throughout the country.

In 1950, as recipient of a Gug-



genheim Fellowship, Brewer was able to work in London with Dr. A. Gaydon on the heat of dissociation of nitrogen. More recently he has collaborated with the physics and astronomy departments at Berkeley in an extensive spectroscopic study of gaseous molecules of astronomical interest, since the molecules of importance in high temperature systems are also important in the stars. A good deal of attention has been directed toward the carbon species C, C<sub>2</sub>, and C<sub>3</sub>.



#### Robert W. Schneider

HOW TO BUY PRESSURE VESSELS. PAGE 183.

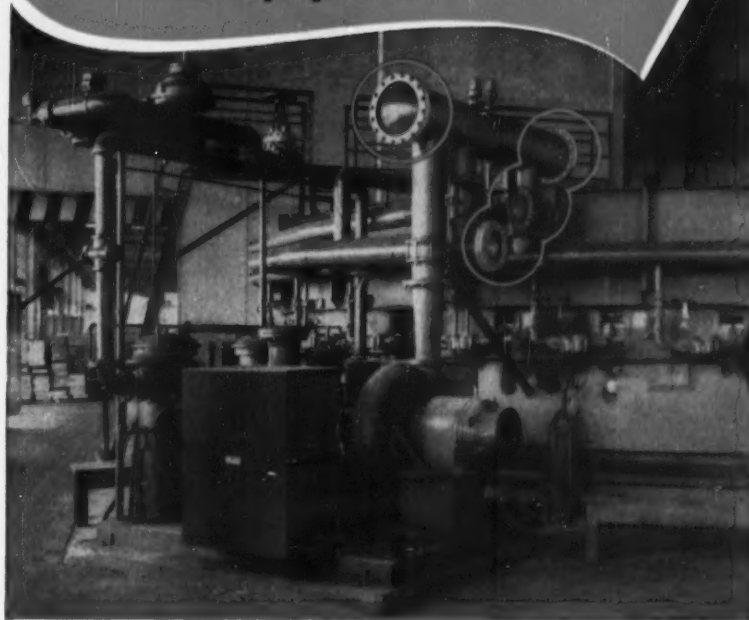
Bob Schneider has spent most of his chemical engineering career with pressure vessels. After taking two chemical engineering degrees at Lehigh University (BS, 1948; MS 1949) he went to work as an assistant design and metallurgical engineer with Linde Air Products Co., at Tonawanda, N. Y.

At Linde, Bob's work consisted of designing pressure vessels for use in Linde plants for production and storage of gaseous and liquid oxygen, nitrogen and argon.

He also designed and supervised the drafting of many vessels purchased from Linde by other divisions of Union Carbide & Carbon Corp. This equipment included rectification columns, autoclaves and other process equipment.

Leaving Linde in 1953, he joined the Engineering & Loss Control Div. of The Travelers Insurance Co., Hartford, Conn. He is now in charge of Travelers' shop inspection service for fabricating shops that manufacture

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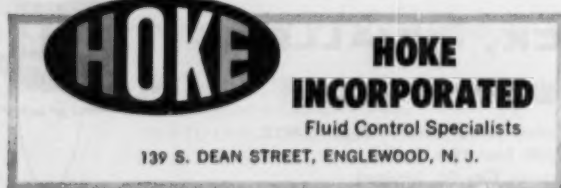
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### AUTHORS . . .

ASME Code boilers and pressure vessels.

This is Bob's second feature article in *Chemical Engineering*. He authored "Help in Designing Pressure Vessels" in our Feb. 1956 issue, and has also written for "The Plant Notebook."

Professionally, Bob Schneider is active in Sigma Xi, the American Welding Society, and ASME. He is an alternate member of the Chemical Industry Advisory Board of the American Standards Assn.

For relaxation, Bob prefers fishing and 35-mm. slide photography.



Rudolph L. Fiske

### HOW TO CLEAN EQUIPMENT CHEMICALLY, PAGE 187.

Rudolph Fiske is manager of the General Industries Div., Oak-ite Products, Inc. In this position, he supervises sales promotion and development work on the cleaning problems of chemical, paper, power, rubber, aviation and automotive industries.

Typical of the work Fiske does to spread information about chemical cleaning was a late summer visit to the campus of Michigan State University. There he addressed members of the National Tank Truck Carriers Institute on "How to Clean Tank Truck Interiors."

At other times he has talked before groups such as the Paper Mill Superintendents' Assn.

In his home town of Hempstead, Long Island, Fiske has driven roots deep into the affairs of the community. Although he and his wife are raising three children, Fiske still has found time to serve as president of the Civic Assn. and chairman of the Community Chest. And he acts as explorer



leader for the Boy Scouts of America.

But the all-consuming interest of Rudy Fiske's life is music. He is an accomplished pianist who plays professionally and listens to everything from jazz to symphony on his hi-fi equipment.



#### H. E. Anderson

THE COMING NUCLEAR INDUSTRY (A CHEMICAL ENGINEERING REPORT), PAGE 191.

H. E. Anderson, engineering consultant of Burbank, Calif., has a rich and varied background in atomic energy work.

He's a firm believer in the future of commercial atomic energy, and in the tremendous opportunities this developing industry offers to chemical engineers and chemists.

A graduate (BS in chemistry) of Indiana Univ., Anderson joined the Atomic Energy Commission in 1946, following four years of military service. There, as chief of the special projects branch in N. Y., he evaluated the technical adequacy of work plans and project designs.

In 1948 he joined the GE Hanford operations at Richland, Wash., as a senior supervisor of design and plant expansion problems. He was involved in construction of a nuclear research and technical center, and radiochemical and other facilities.

Leaving GE, Anderson associated himself first with the Bechtel Corp. in Los Angeles as senior process engineer on refinery and petrochemical problems, then with the Lockheed Missile Systems Div., as senior scientist. He left to go into consulting work and just recently has joined Paul Hardman, Inc.,

**FROM THIS**

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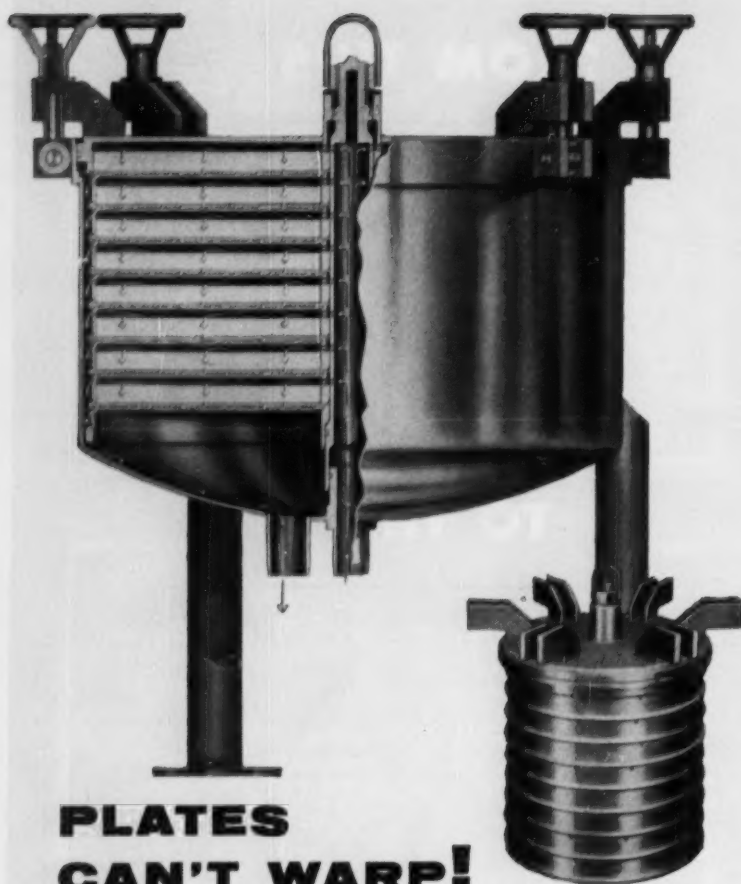
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### AUTHORS . . .

as manager of the nuclear engineering dept.

Anderson is a member of the American Nuclear Society, but for recreation is a racing enthusiast, particularly speed-boat and car racing. In addition, he is interested in skiing and photography.



**Gordon T. Bedford**

TITANIUM MOVES INTO  
PROCESS EQUIPMENT. PAGE  
238.

Gordon Bedford is a sales engineer for Rem-Cru Titanium, specializing in market development since 1954. A graduate of University of Michigan in 1939 with a degree in metallurgical engineering, he joined the Rustless Iron & Steel Corp. in Baltimore and supplemented his education at Johns Hopkins Univ. When Rustless became a division of Armco Steel Corp., Mr. Bedford continued in production and metallurgical work and later in market development.



**Walter A. Weeks**

TITANIUM MOVES INTO  
PROCESS EQUIPMENT. PAGE  
238.

Walter Weeks is on the sales engineering staff of Rem-Cru



Titanium, Inc., handling customer service.

Upon graduation from MIT as a chemical engineer, he joined the Bakelite Co., in the foreign sales department, where he specialized in plastics for corrosion resisting purposes.

From 1951 to 1954, he was associated with the Industrial Sales Division of Remington Arms Co., Bridgeport, Conn. In 1954, he joined Rem-Cru.

During the Second World War, Weeks served with the infantry in Europe. He is still active in the reserves.



**Alan G. Caterson**

**TITANIUM MOVES INTO PROCESS EQUIPMENT. PAGE 238.**

Alan Caterson prepares and edits technical literature on titanium for Rem-Cru Titanium, Inc., Midland, Pa.

He graduated from Fordham University in 1942 with an AB degree in journalism. While an officer in the U. S. Air Force meteorological service, after a year's study at Massachusetts Institute of Technology, he became increasingly interested in the sciences. From 1945 until 1948, he was employed as a sales engineer by Edgcomb Steel Corp. He received his MS in metallurgy from Stevens Institute in Hoboken in 1950. Between 1949 and 1952, he was employed by the research department of Westinghouse at Bloomfield, N. J., supplementing his education in metallurgy at Columbia University.

At Rem-Cru Titanium, Caterson's assignments utilize his journalistic and metallurgical backgrounds. Hobbies are duplicate bridge and collecting information about the Civil War.



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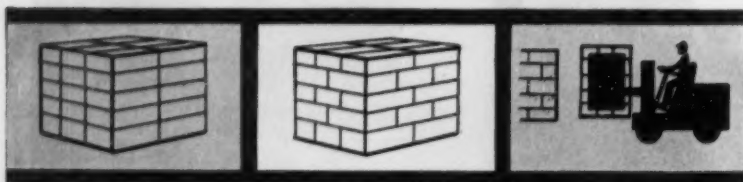
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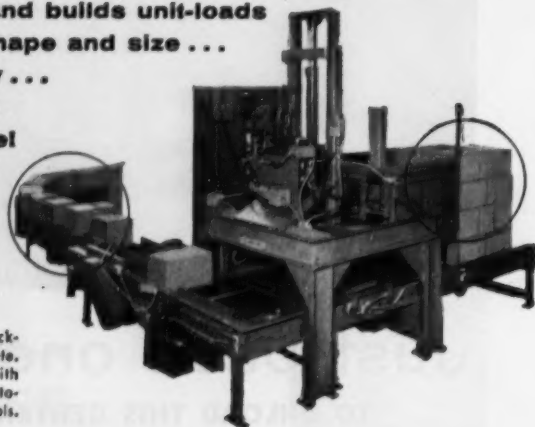
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THIS MONTH'S

## Technical

### Thermochemistry

**EXPERIMENTAL THERMOCHEMISTRY.** Measurements of Heats of Reaction. Edited by F. D. Rossini. Interscience Publishers, New York. 341 pages. \$7.80.

*Reviewed by G. J. Janz*

This book has been prepared by members of the Subcommittee on Experimental Thermochemistry, International Union of Pure and Applied Chemistry, and makes available the best knowledge of these members in this important field.

The fundamental principles of modern thermochemistry, physicochemical standards, evaluation of errors and assignment of uncertainties to thermochemical data are clearly developed.

Thermochemistry of reactions in a bomb at constant volume and in a flame at constant pressure is treated in detailed accounts. Discussions of the thermochemistry of combustion in a bomb of hydrocarbons and organic compounds containing oxygen, nitrogen, sulfur and halogens make available, for the first time in a book, the details of many experimental steps important to the attainment of precise results from such measurements.

The book provides a valuable guide to investigators for meeting the rigid standards of precision work and resolving the difficulties inherent in such measurements. Sections treating reactions other than combustion and the microcalorimetry of slow phenomena call attention to additional important areas of thermochemistry.

This text draws on the work of some 13 different contributors from England, France, the Netherlands, Sweden and the U. S. It is clearly written and, except for minor points (e.g., some style changes and use of different symbols for the same quantity), presents a unified account of the field of experimental thermochemistry.



## Bookshelf

EDITED BY R. K. GITLIN

Physical chemists, thermodynamicists, thermochemists and anyone working in this field will find this volume most useful as a reference and guide towards the achievement of better and more meaningful results in experimental thermochemistry.

### Law and Engineering

**LEGAL PROBLEMS IN ENGINEERING.** By M. Nord. John Wiley & Sons, New York. 391 pages. \$7.50.

*Reviewed by A. W. Deller*

For many years there has been a pressing need for a book on legal subjects akin to engineering activities. The author has filled this need by providing a comprehensive text relating law to the work of the engineer.

The book doesn't try to make a lawyer out of the engineer. It merely serves as a legal guide. Main headings and subheadings not only make it easy to find the topics desired, but also make for easy reading and understanding.

► **Case Histories Cited**—Under each subheading, explanatory text is nonlegal and readily understood. Throughout the book, case histories are cited. Each case states the facts, poses the problem, then offers a detailed solution. In some cases, reference is made to another text or case for additional information on the subject in question.

At the end of each chapter dealing with a legal subject, there are a number of problems which involve interesting cases and pertinent questions. Solutions to these aren't given. Instead, reference is made to cases where the reader may find the answers.

These problems would be very useful in teaching a law course in an engineering school. But one difficulty exists: References are made to law books which are not readily available except in large, modern law libraries. It might have been better, therefore, to have referred to law books or legal encyclopedias



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## Standardaire Blower unloads 20 tons of flour in 50 minutes

In the next 50 minutes, this one operator will have unloaded twenty tons of flour from this huge International Milling Company trailer directly into a baker's storage bins.

The problem of rapidly unloading flour in such quantity, with no leakage, clogging or contamination, was solved by a *Standardaire* blower . . . the only blower found capable of meeting all the specific requirements involved.

This blower (shown in the front of the van) occupies a floor space of only 26" x 21 $\frac{1}{4}$ ". When driven by a 20 hp motor it provides an air flow sufficient to move flour as far as 125 feet in any direction . . . including straight up.

Today, due to its proved satisfactory performance, International Milling Company, Minneapolis, one of the largest millers of bakery flour in America, has equipped its entire fleet of bulk flour trucks with *Standardaire* blowers.

A *Standardaire* blower will deliver more air, with less power consumption, than any other unit of equal size or weight. Find out about its many advantages. Write for bulletin B-154 today.

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### BOOKSHELF . . .

which are more readily accessible throughout the country.

► **What the Engineer Should Know**—Part I, the introduction, covers basic legal fundamentals and provides a good background for the material which follows. For ease of understanding, analogies are made to the laws of nature.

Part II deals with legal principles which engineers should know: contracts; law of sales; negotiable instruments; insurance; personal property; real property; workmen's compensation and common-law liability; agency; business organizations; public utilities; municipal corporations—their nature, creation, powers, liability; labor law.

One chapter in this section is concerned with a term unfamiliar to most engineers—torts (legal wrongs of a private nature). The author presents a comprehensive discussion of the subject and includes a detailed discussion of such torts as assault and battery, false imprisonments, trespass, waste, negligence, nuisance, fraud, defamation.

Part III covers professional problems of engineering and includes a discussion of the engineer's ethical responsibilities (most of which can be found in "Canons of Ethics for the Engineer") and professional registration.

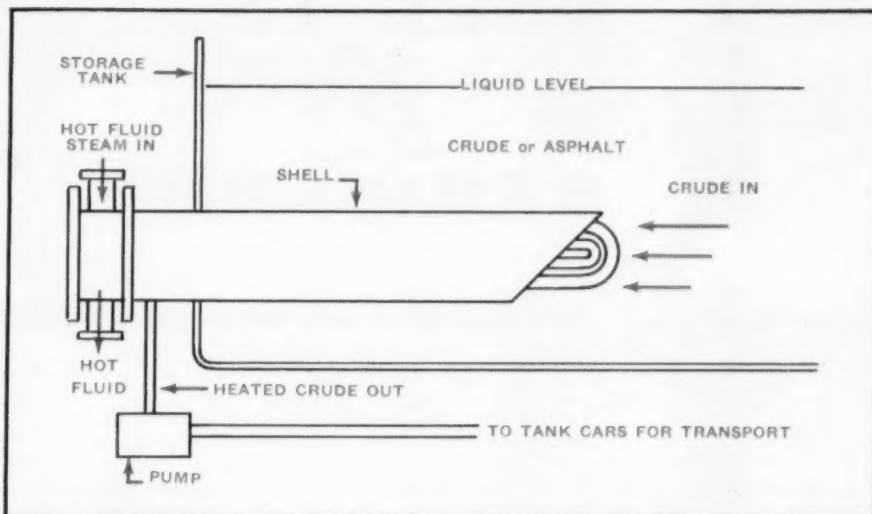
► **Worth the Price of the Book**—The last section, Part IV, relates to engineering-legal problems. A highlight of this section—and of the book itself—is the excellent coverage of construction contracts and specifications. This highly informative chapter starts with construction contracts in general; then takes up the contracts system, competitive-bid contracts, lump-sum contracts, unit-price contracts, cost-plus contracts, etc.; and concludes with information on advertisements, instructions to bidders, proposals, statement of work to be done, price, construction time, liquidated damages, surety bonds, payments, etc.

Rounding out Part IV are chapters on government regulation of business; patents, copyrights and trademarks; and the increasingly important problem of air and stream pollution.

► **Fills a Long-Vacant Space**—To the engineering profession in



# TEXANS SHOW HOW TO HURRY CRUDE FROM STORAGE



## TRUFIN TYPE S/T IS WIDELY USED

Day by day throughout the entire heat transfer field, Wolverine Trufin Type S/T is being used in an increasingly large number of applications. Typical of the uses to which engineers are putting this capacity-boosting and cost-cutting integral finned tube, are: condensing freon and other refrigerants, condensing hydrocarbons, condensing organic chemicals, evaporating freon-water chillers, boiling hydrocarbons, heating or cooling gases, heating or cooling lube oils, transformer oils, absorber oils and quench oils.

Type S/T can be specified in any of a wide range of sizes and alloys in copper, aluminum or electric-welded steel. It is available with either 16 or 19 fins per inch. Because its integral fins give added support on bends, Trufin Type S/T can be fabricated just as readily as plain tube.

## GOT A PROBLEM? JUST ASK F.E.S.

Among the many services Wolverine maintains for the convenience of its customers is the staff of highly trained tubing technicians in its Field Engineering Service.

These men, in addition to their individual training and knowledge, can

draw on Wolverine's background of tubing experience to help solve customers' problems in design, corrosion, fabrication, etc. The staff is available at all times and their services impose no obligation.

## SEND FOR FREE BOOK!

One of the most comprehensive sources of information available on finned tube is Wolverine's Trufin Opportunity Book. In addition to much background data, this book contains valuable information on designing with integral finned tube. There are a number of actual Trufin case histories describing performance boosts and cost reductions made possible by Trufin Type S/T. There is no charge for this book. Write for your copy—today.



## INTERCHANGEABILITY

Complete interchangeability with prime surface tube is an important feature of Wolverine Trufin Type S/T. When retubing with Type S/T, only standard tools and tubing techniques are required. There is no deviation from normal procedure.

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WOLVERINE TUBE DIVISION  
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EQUIPMENT COMPANY LIMITED

## FINNED U-BEND TUBES SPEED WORK, CUT COSTS

by Ernest Dodd

Down Texas way, engineers are using a highly efficient and economical method for putting a little hustle into crude as it is moved from storage tanks at ambient temperatures.

Instead of tank suction heaters using prime surface tube, the Texans designed new heaters around Wolverine Trufin® Type S/T, finned tube of electric-welded steel, in U-bend form. The results—from the standpoint of both performance and economy—have been most satisfactory.

For example, because its integral fins give Trufin more than twice the effective heat transfer surface of plain tube, it was possible to design smaller heaters using fewer tubes. The result was a substantial saving in direct tube costs.

Despite their smaller size, the new units—with super-heated steam on the tube side—heat the crude from normal temperatures to 250°-300° F. This allows large quantities of the highly viscous crude to be withdrawn from the tank at a greatly increased rate of flow. The design used is a simple, single shell side pass over the U-bend tubes.

In addition to outstanding performance and the direct savings made in tube alone, the use of Wolverine U-bend tubes also contributed further savings in labor and material.

U-bend tubes were prefabricated by Wolverine to exchanger prints and packaged in expendable pallets in the exact order of their installation. On receipt of shipment it was only necessary for the equipment manufacturer to feed them directly from the pallet into the unit. Their use also resulted in the elimination of one tube sheet, a reduction by half of rolling-in operations and the elimination of floating head problems.



**WOLVERINE TUBE**

Division of Calumet & Hecla, Inc.

1443 Central Avenue, Detroit 9, Michigan

Manufacturers of Quality Controlled Tubing and Extruded Aluminum Shapes



# *The* CONDENSER TUBE *for* REBOILERS

Although the condenser tubes they now use are still made of low carbon electric-welded steel, engineers at a large refinery have discovered that the addition of integral fins can work miracles in reboiler operations.

Simply by changing from plain tube to Wolverine Trufin Type S/T U-bend condenser tubes, the engineers stepped up reboiler capacity and greatly reduced the cleaning frequency. In addition, the use of U-bend tubes also eliminated the cost and maintenance of the floating head.

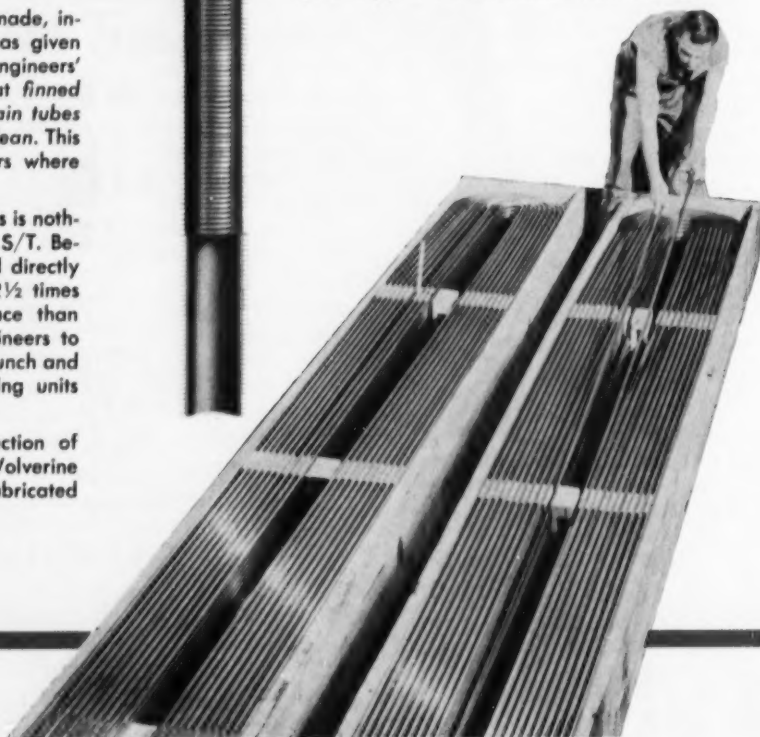
However, before the change was made, integrally finned Trufin Type S/T was given extensive laboratory tests. To the engineers' amazement these tests proved that *finned tubes do not foul as readily as plain tubes and, that once dirty, are easier to clean.* This is of major importance in reboilers where shell side fouling is great.

Boosting capacity and reducing costs is nothing new for Wolverine Trufin Type S/T. Because its integral fins are squeezed directly from the tube wall, Type S/T has  $2\frac{1}{2}$  times more effective heat transfer surface than does plain tube. This enables engineers to design smaller units with a bigger punch and to skyrocket the capacity of existing units when retubing.

In addition to its exclusive production of integrally finned condenser tube, Wolverine is also a direct mill source for prefabricated U-bend tubes.

Wolverine ships U-bends to the user in expendable pallets. They are removed in the exact order of their installation — reducing unit fabrication time, eliminating one tube sheet and cutting rolling-in operations by half.

If your plant operates reboilers, Wolverine Trufin Type S/T U-bend condenser tubes can help you increase capacity and reduce costs. Specify them for new equipment or when retubing. For complete information write for your copy of the Wolverine Trufin Catalog.



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Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario

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general, to teachers and students of engineering, this volume should prove a great aid in understanding legal problems which arise in engineering. The professional engineer, too, will find it very valuable in his practice.

In short, the author's book fills a space on the engineer's shelf which has long been vacant.

#### Molecular Architecture

**STERIC EFFECTS IN ORGANIC CHEMISTRY.** Edited by M. S. Newman. John Wiley & Sons, New York. 717 pages. \$12.50.

*Reviewed by F. C. Nachod*

There was a time when organic chemistry was a descriptive and preparative science, when a man interested in synthetic work would take compounds from the shelf, carry out a reaction, fish out a product and try to characterize it. Not so in this present decade!

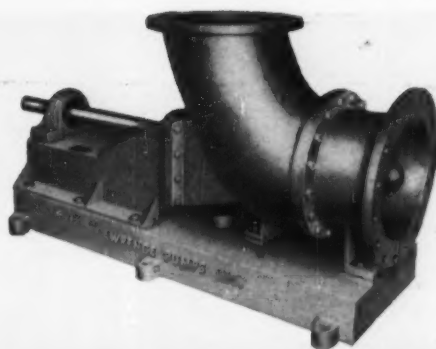
No, nowadays, physical chemists, organic chemists and even theoretical physicists get together and plan the synthesis. They draw blueprints of mechanisms and they calculate steric interactions and improbable (or even impossible) molecular architecture.

In 13 well-written chapters, 12 well-qualified men report on how much we have learned about steric effects in organic chemistry. Prof. Melvin S. Newman of Ohio State University has been an able coach for this team. It is a pleasure to recommend this excellent book unequivocally to theorists and to bench workers, to students (graduate) or teachers, to industrial or academic chemists.

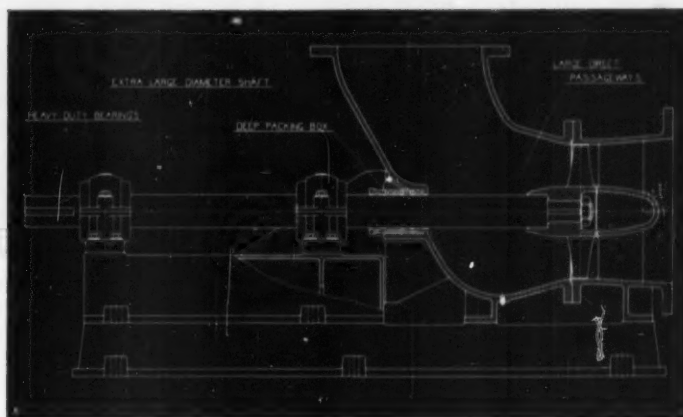
#### ABC's of ABACS

**ABACS OR NOMOGRAMS.** By A. Giet. Philosophical Library, New York. 225 pages. \$12.

By far the most intriguing aspect of this offering is its title. It's taken literally from the original French, "Abaques ou Nomogrammes" which translates roughly into "Graphic Tables or Nomograms." Disregard both



Lawrence 24" Horizontal Circulating Pump of Nickel Alloy Construction



Cross Section of Lawrence Horizontal Propeller Pump

## PROPELLER PUMPS FOR THE CHEMICAL and PROCESS INDUSTRIES

Lawrence Propeller or Axial Flow Pumps are widely used to circulate large volumes of liquid or slurry against low heads as in evaporators, crystallizers, etc. This type of pump is particularly well adapted for circulating service because of its simplicity, high efficiency, and low first cost. The flow can be arranged in either direction and the casing turned to any position desired to serve as an elbow. The capacity can be closely regulated by varying the speed—very important in crystallization processes where a uniform velocity must be maintained.

Lawrence Propeller Pumps are made of the metals and alloys best suited for their ability to resist the corrosive and abrasive action of the liquid pumped.



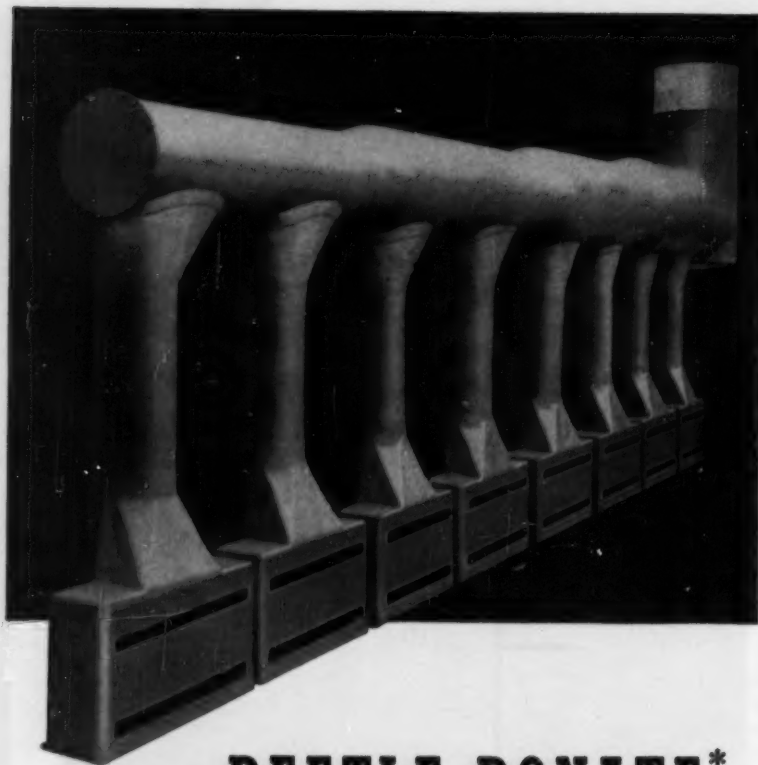
Write for Bulletin 203-7 for summary of acid and chemical pump data.



# LAWRENCE PUMPS INC.

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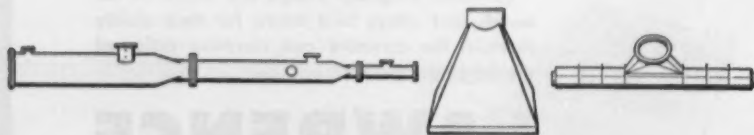
**backbones the ruggedest, most-efficient vent and ducting systems in the chemical industry**

Lighter than most resin compounds, more durable by far than sheet metal, Beetle Bonate vents, ducts and hoods can take it! Proven non-corrosive, Beetle Bonate withstands constant exposure to chemical fumes or atmospheres.

Beetle makes vents, hoods, pipes and ducts from Bonate to any specifications of size or shape. Bonate equipment is simply installed without special equipment or experience.

Fully-descriptive literature and qualified engineering consultation is yours immediately upon request. No obligation, of course!

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### BOOKSHELF . . .

British and French titles. We have here a new book dealing with theory, construction and use of Cartesian coordinate charts and nomographs.

With that worry off your mind, let's look beyond the cover. I find nothing there that's superior to any good American book on nomography—seven of which are within arm's reach on my bookshelf.

Principal interest in M. Giet's *livret* will lie in an extended exposition on relations between  $n$  variables when  $n$  is four or more. Better than half the book is devoted to this extension of abac and alignment chart theory. Some of the guidance here may prove useful to those of you who must work with complex equations.

The book has not been translated into English. Instead it "tries to convey M. Giet's ideas in what seemed . . . the clearest possible way for British readers." But let our non-British engineers and mathematicians not worry. They'll understand it if they try and if they have the equivalent of approximately 86 shillings.—LBP

### Briefly Noted

**THE PETRIFIED RIVER—STORY OF URANIUM.** *Bureau of Mines, Dept. of Interior, Washington, D. C.* A 28-minute, narrated color film sponsored by Union Carbide and Carbon Corp. and the Bureau of Mines and produced by MPO Productions, New York. Tells how uranium was deposited back in geologic time; about search for uranium on the Colorado Plateau; how metal is mined and milled; some ways that atom's energy is being put to work for benefit of mankind. Film prints available free, on request, from Bureau of Mines.

**STANDARD X-RAY DIFFRACTION POWDER PATTERNS.** *National Bureau of Standards Circular 539, Vol. 6. 62 pages. 40¢.* By H. E. Swanson, N. T. Gilfrich, M. I. Cook. *Government Printing Office, Washington 25, D. C.* Presents 44 standard X-ray diffraction powder patterns, 23 of which replace 33 patterns already represented in the X-ray Powder Data File. Comparison is made of all powder diffraction data available for each substance reported.



Patterns were made with a Geiger counter X-ray diffractometer using high-purity samples.

**AUTOMOTIVE ANTIFREEZES.** *National Bureau of Standards Circular 576.* 23 pages. 15¢. By F. L. Howard, D. B. Brooks, R. E. Streets. Government Printing Office, Washington 25, D. C. Offers information on basic properties of various types of antifreezes, including some which have potentially hazardous effects. Provides technical data on corrosion, identification of types of antifreezes, performance requirements. An extensive bibliography is included.

**FLUID AGITATION HANDBOOK.** 46 pages. \$1.50. *Chemineer, Inc., 1044 E. First St., Dayton 2, Ohio.* Covers, in detail, theoretical and practical approaches to fluid mixing problems in the process industries. Outlines step-by-step procedures for determining optimum mixing characteristics of fluids in relation to their physical properties. Book, originally part of an experimental mixing kit, contains many added charts, diagrams and photos which haven't appeared in print before.

**UTAH'S ECONOMIC PATTERNS.** 345 pages. \$4.75. By E. Nelson. *University of Utah Press, Salt Lake City, Utah.* Discusses Utah's population; agricultural and agricultural processing industries; metals; nonmetallic minerals; manufacturing; construction, transportation and utilities; service industries.

**ASTM MANUAL FOR RATING MOTOR FUELS BY MOTOR AND RESEARCH METHODS.** 180 pages. \$6.75. *American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.* Provides revised, up-to-date ASTM methods for determining knock characteristics of motor fuels plus six appendices containing information and data on operation and maintenance of knock testing equipment.

**ASTM STANDARDS ON MINERAL AGGREGATES AND CONCRETE (WITH SELECTED HIGHWAY MATERIALS).** 348 pages. \$3.75. *American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.* Contains 98 standards in their latest forms—56 test methods, 33 specifications, 8 definitions of terms, 2 recommended practices. Subjects covered include specs and test methods for aggregates; ready mixed concrete; air en-

## SMSROTOVALVES

### —STILL THE BEST VALVE YOU CAN BUY

Only Rotovalves give you all these features:



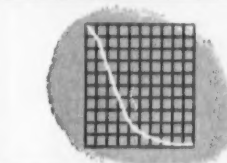
#### LEAST PRESSURE LOSS

Full line opening means less head loss, lower pumping costs.



#### EASIEST TO OPERATE

Hydraulic imbalance and mechanical design mean 1 man can close as fast as required. Less power needed in mechanical or electrical operation.



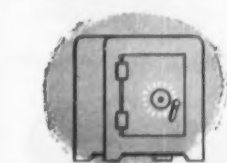
#### GREATEST INITIAL SHUT-OFF

Rotovalve 55% closed at 25% stroke, and 92% closed at 50% stroke. In comparison, gate valves only 18% closed at 25% stroke and 43% closed at 50% stroke.



#### MOST CONTROLLED CLOSING TIME

Closing as quickly as one second or as slow as needed. Fast initial closing limits reversal of flow.



#### MOST POSITIVE CLOSING

Drop-tight, positive closing. Self-purging, monel-to-monel seating. Pressure-tight bolted head, stuffing box, and machined and lapped seats.

In addition to all these features typical of SMS engineering, Rotovalves have a flexibility that makes them suitable for any type of operation, any method of control, or any sort of location.

For detailed information about SMS Rotovalves, Ball or Butterfly Valves, see our local representative or write to the S. Morgan Smith Company, York, Pennsylvania.

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HYDRAULIC  
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# GOT A PUMPING PROBLEM?

PERHAPS THE ANSWER YOU'RE LOOKING FOR IS A ROPER ROTARY PUMP

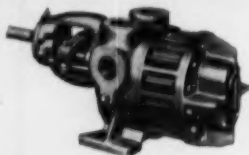
## ROPER PUMP-MOTORS

These units offer low-speed and high-torque, and their versatility finds them well-suited to heavy-duty service within their operating range. In general, recommended speed is 200 to 800 R.P.M. with pressures to 800 P.S.I. In this range, they require from 7 to 40 G.P.M. flow and will develop up to 11.5 H.P. output at maximum speed and pressure.



## ROPER SERIES F PUMPS

Among the dependable Ropers is the Series F Pump — pressures to 300 P.S.I., sizes 1 to 300 G.P.M. It features four-port design with 8 optional piping arrangements . . . supplied in standard fitted models. With packed box or mechanical seal; with or without relief valve.



## ROPER SERIES K PUMPS

Operate your hydraulic circuit with the correct size Roper for the particular job. In many cases the Series K will do, for it is rated from pressures to 150 P.S.I., capacities ¼ to 50 G.P.M. This model is compact, sturdy . . . is self-lubricated by liquid pumped. Comes with packed box or mechanical seal . . . with or without relief valve.



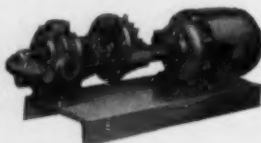
## ROPER SERIES H PUMPS

Lower maintenance costs with a Roper. For instance, a pump like the Series H with pressures to 1000 P.S.I., sizes 10 to 75 G.P.M. is ideally suited for hydraulic mechanisms and for other applications requiring high pressures. Spur gears run in axial hydraulic balance . . . roller bearings and bronze wear plates reduce friction. Available with packed box or mechanical seal.



## ROPER SERIES 3600 PUMPS

You'll profit more with dependable Roper Series 3600 Pumps on the job . . . they are speedy, quiet, and plenty rugged. Service-proved features such as self-lubrication, adjustable relief valve, hardened gears, and mechanical seal contribute to Roper dependability. Sizes range from 40 to 300 G.P.M.; pressures to 60 P.S.I.



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## BOOKSHELF . . .

training admixtures; test methods for concrete's air content, compressive strength, flexural strength, freezing and thawing, slump; brick and block pavement materials; concrete curing materials; expansion joint fillers; cement.

PROCEEDINGS OF THE FOURTH WORLD PETROLEUM CONGRESS. SECTION IV. 360 pages. Carlo Colombo Publishers, Rome, Italy. Compilation of 28 papers, 25 of which were presented and discussed at the 1955 World Petroleum Congress in Rome. Each paper, falling under one of three major categories—production and utilization of olefins, oxidation of hydrocarbons, various developments—is prefaced by a brief resume in English, French and Italian.

A MANUAL OF PROCESSES FOR COLD BENDING OF METALS AND ABRASIVE CUT-MACHINING OF METALS. 162 pages. \$2.50. Wallace Supplies Mfg. Co., 1300 Diversey P'way., Chicago 14, Ill. Describes types of bending machines use for cold bending of tube, pipe and structural shapes; tools for bending, designing for bending, theory of cold bending. Also deals with why abrasive wheels sometimes fail, how to prevent failure, what cut-machining will do for you.

ALLIED'S ELECTRONICS DATA HANDBOOK. 64 pages. 35¢. Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. Consists of collection of most-often needed formulas and data used in radio and industrial electronics. Formulas include those needed for basic circuit analysis, transmission line calculations, determination of vacuum tube characteristics, resonance calculations. Also contains tables of logarithms, trigonometric functions, decimal equivalents of fractions, etc.

MARKING TECHNIQUES. 34 pages. \$1.25. Association of British Chemical Manufacturers, Cecil Chambers, 86, Strand, London W. C. 2, England. Guide to methods of marking containers of hazardous chemicals. Describes practical problems involved and methods available for application of markings to containers.

PANEL DISCUSSION ON PYROMETRIC PRACTICES. 41 pages. \$1.50. American Society for Testing

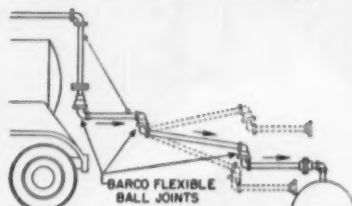


*Materials*, 1916 Race St., Philadelphia 3, Pa. Includes papers on thermocouple immersion errors, summary of pyrometric procedure employed by one company in creep-rupture testing and an analysis of results obtained, creep and rupture test pyrometry.

#### MORE NEW BOOKS

- ADVANCES IN CATALYSIS.** Vol. VIII. Edited by W. G. Frankenburg, et al. Academic Press. \$10.
- ATOMIC ENERGY.** By A. Radcliffe and E. C. Roberson. Philosophical Library. \$4.75.
- CHANGES OF STATE.** By H. N. V. Temperley. Interscience. \$7.50.
- CHEMICAL ENGINEERING PRACTICE.** Edited by H. W. Cremer. Academic Press. Vol. I—General. \$17.50. Vol. II—Solid State. \$17.50.
- CHEMISTRY OF CEMENT AND CONCRETE.** By F. M. Lea. St. Martin's Press. \$15.
- CREATIVE COMMUNICATION.** By E. L. Cady. Reinhold. \$2.50.
- DICTIONARY OF POISONS.** By I. Mellan and E. Mellan. Philosophical Library. \$4.75.
- DISCOVERY OF THE ELEMENTS.** 6th ed. By M. E. Weeks. Journal of Chemical Education. \$10.
- DISPOSAL OF SEWAGE AND OTHER WATER-BORNE WASTES.** By K. Imhoff, W. J. Muller and D. K. B. Thistlethwaite. Butterworths. 45 s.
- ELEMENTS OF X-RAY DIFFRACTION.** By B. D. Cullity. Addison-Wesley, \$10.
- ENGINEERING AS A CAREER.** By R. J. Smith. McGraw-Hill. \$4.75.
- ENGINEERING INSPECTION MEASUREMENTS AND TESTING.** By H. C. Town and R. Colebourne. Philosophical Library. \$8.75.
- INDUCTION HEATING PRACTICE.** By D. Warburton-Brown. Philosophical Library. \$10.
- INTRODUCTION TO SOLID STATE PHYSICS.** 2nd ed. By C. Kittel. Wiley \$12.
- MARGARINE AND OTHER FOOD FATS.** By M. K. Schwitzer. Interscience. \$7.
- MOLYBDENUM.** Metallurgy of the Rarer Metals—No. 5. By L. Northcott. Academic Press. \$6.80.
- PHOTOCONDUCTIVITY CONFERENCE.** Edited by R. G. Breckenridge, et al. Wiley. \$13.50.
- PROPERTIES OF COMBUSTION GASES.** System: C<sub>2</sub>H<sub>4</sub>—Air. Vol. I—Thermodynamic Properties. Vol. II—Chemical Composition of Equilibrium Mixtures. By Aircraft Gas Turbine Development Dept., General Electric Co. McGraw-Hill. \$75 (set).

## For SAFETY and Lower Costs in Handling Sulfuric Acid



The accompanying sketch shows how three Barco Ball Joints in unloading (or loading) line provide complete flexibility for making connections in any position. Note how line folds neatly on back of truck when not in use (photo below).



## Barco Flexible Ball Joints Replace Hose

Two near-accidents with hose blowing out some time ago, while handling sulfuric acid with 30 psi air pressure, caused Rogers Cartage Co. of Chicago to change to Barco Flexible Ball Joints (with malleable iron casing and stainless steel ball) in loading lines on some 15 big trucks serving many chemical, petroleum, steel, and other customers in the Midwest area. Since making the change, Mr. Jack Kidder, Rogers Safety Manager reports that there have been no failures and little or no maintenance on the joints. Cost for frequent hose replacement has been eliminated. *Inquiries are invited, address Barco. Ask for Catalog 215B.*

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**NO METAL-TO-METAL CONTACT BETWEEN MOVING PARTS**—No ball bearings to corrode.

**CHEMICALLY INERT GASKETS**—No. 11-CT for corrosive service. Suitable for many liquid chemicals.

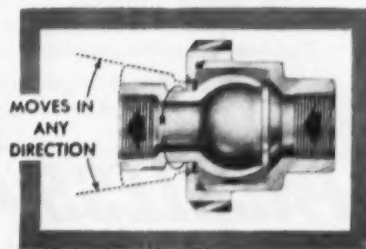
**PRESSURE-SAFE! FIRE-PROOF!**—Unequaled for SAFETY, DURABILITY, ECONOMY.

**CHOICE OF STYLES**—Angle or straight. Sizes 1/4" to 6". Available in choice of metals, including stainless steel and special alloys.

**APPROVED**—By leading chemical manufacturers and trucking associations.

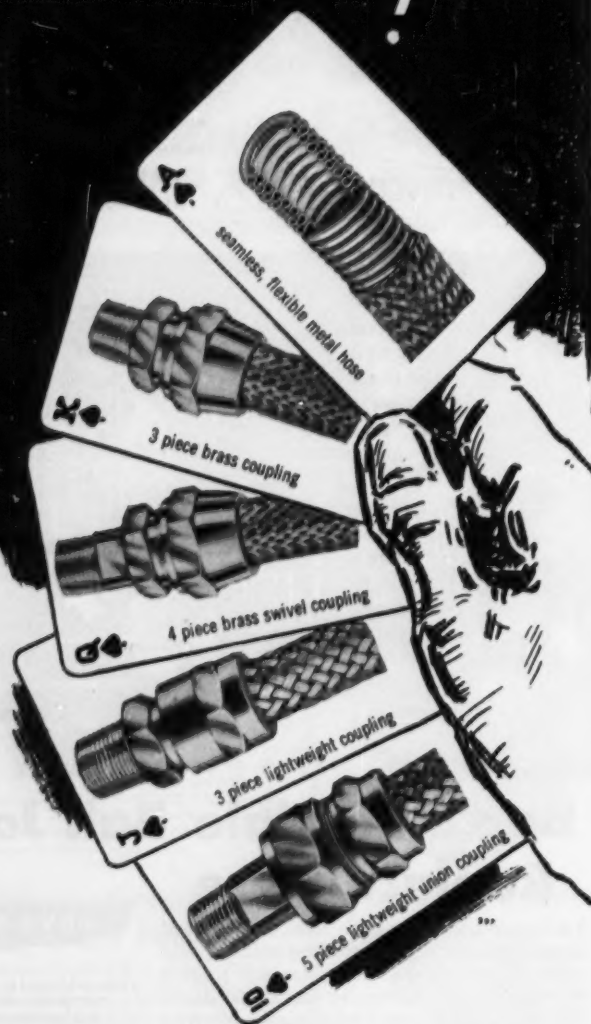
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**A SURE THING  
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The Packless® PATENTED RE-USABLE COUPLINGS are fitted without heat by a simple, clean mechanical process, accomplished in minutes at your plant.

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For longest connector life, stock Packless® seamless drawn helical metal hose in random lengths for use as required with Packless® re-usable couplings. Sizes from 1/4" to 1 1/2" I.D.

Send now for your copies of Bulletins DC and IND-4 for complete detailed information

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## Firms in

### NEW NAMES

**Thor Corp.** has changed its name to **Allied Paper Corp.** to better identify itself as a producer of book and specialty papers.

**Nuclear Instrument & Chemical Corp.**, Chicago, has changed its name to **Nuclear-Chicago Corp.**

**Pacific Coast Aggregates, Inc.**, San Francisco, which early this year purchased the business and manufacturing plant of Santa Cruz Portland Cement Co., has changed its name to **Pacific Cement & Aggregates, Inc.**

### NEW COMPANIES

**Propellex Chemical Corp.** has been formed in Edwardsville, Ill., to conduct research on, and manufacture of, propellants and explosives.

**Columbian Carbon International de Mexico, S. A.**, has been formed as a wholly-owned subsidiary to represent **Columbian Carbon Co.** in the sale of its carbon blacks, carbon black dispersions and iron oxides in Mexico.

### NEW LINES

**Seiberling Rubber Co.**'s plastics division at Newcomers-town, Ohio, is now producing polyethylene for vacuum formed products.

**Consolidated Electrodynamics Corp.**'s Rochester Div. is now marketing a new type of vacuum pumps and high vacuum laboratory furnaces. Made by **W. C. Heraeus GmbH**, Hanau, West Germany, the equipment has been licensed for sale in the U. S. and Canada by Consolidated.

**Shell Chemical Co.** has started marketing a new concentrated nitrogenous fertilizer



# the News

EDITED BY F. ARNE

in Britain. Called Nitra-Shell, it has a guaranteed nitrogen content of 20.5% and 36% carbonate of lime.

## NEW REPRESENTATIVES

**M. W. Kellogg Co.** has licensed Nuovo Pignone of Florence to manufacture in Italy heat exchangers using Kellogg designs and techniques.

**Enthone, Inc.**, New Haven, Conn., manufacturer of chemicals and processes for metal finishing, has appointed Ross Industries, Detroit, as warehousing distributor for eastern Michigan.

**Baker-Raulang Co.**, Cleveland, has named Bohnert Equipment Co., Louisville, Ky., distributor for its materials-handling trucks.

**Du Pont Co.** has made Howe & French, Inc., Boston, first agent in the country to distribute cyclohexanol and cyclohexanone.

## NEW FACILITIES

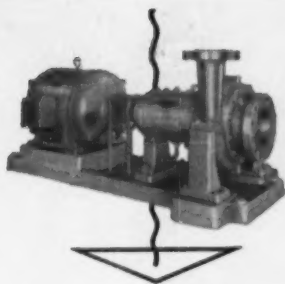
**Wyandotte Chemicals Corp.** has expanded its facilities for producing soda ash in Wyandotte, Mich. Output will be increased by 32%.

**New England Lime Co.** has installed a second complete Dorco FluoSolids System for producing 100 tons of lime per day at its Adams, Mass., plant.

**Parke, Davis & Co.** has opened a sales promotion office in Singapore.

**Stillman Rubber Co.**, Culver City, Calif., and Cleveland, Ohio, has increased production facilities for O-rings and custom molded parts by 30%.

**El Paso Natural Gas Products Co.** near Gallup, N. M., is



## How "heads up" engineering keeps your pump costs down

It takes a lot of pump savvy, a lot of "heads up" engineering, and a big investment to design and build a line of pumps that can withstand the wear and tear of today's continuous process pumping—and still be in line, price-wise.

Dean Brothers did it with their fully engineered line of standard centrifugal pumps. And they have built into these pumps a ruggedness and reliability usually found only in costly, individually engineered pumps. They did it by making practically every component part interchangeable between all pumps in the same series—something never before attempted over such a wide range of application.\*

For example, the eleven pumps in Series 10 can handle 90% of all process pumping jobs. Every one of these pumps is built of the same parts except for the Casing, Impeller, and Suction Nozzle—which vary with the capacity of each pump. And for temperatures up to 350° F. the cradle housing is built without water jackets. *All other parts are the same.* With a single cradle assembly for eleven different size pumps, you get a lot of pump for your money—in soundness of design, in strength, in durability.

If you'd like to know more about the many "long life" features of all Dean Brothers standard centrifugal pumps, send for Circular No. 184B.

\*Series 10, Series 20 and Series 30—to 7,000 gallons per minute capacity.



### HERE'S JUST ONE EXAMPLE

Repacking is costly and time consuming. But because one shaft fits all eleven pumps, Dean Brothers was able to make that shaft extra big and engineer it with an extra short overhang. So shaft deflection is kept to a minimum even under heaviest loads. Result: much less wear on the packing. Protection of the packing against the ravages of heat, in high temperature service, is assured by a *water jacket which completely encircles the entire length of the stuffing box*.

And when a mechanical seal is used, it fits into the same stuffing box—a neat bit of cost-saving standardization.



## DEAN BROTHERS PUMPS INC.

INDIANAPOLIS 7, INDIANA

Centrifugal and Reciprocating Pumps • Since 1869





## VISCOSITY\*

\*"That property of a body in virtue of which, when flow occurs inside it, forces arise in such a direction as to oppose the flow." — Webster

## BROOKFIELD\*

\*Pioneer and world leader in the development and manufacture of precision viscosity instruments. Today, Brookfield is universally accepted as the World's Standard for Viscosity Measurement and Control!

## AND YOU\*

\*A scientist interested in easy, accurate viscosity measurement or control for laboratory or production processes. You'll be happy to learn, too, that more than 300 technical articles and references based on Brookfield and viscosity measurement of 200 different materials have been published in the past ten years. You are welcome to any of this data which may pertain to viscosity measurement control problems you have.

The world's standard  
for viscosity  
measurement and control



Brookfield know how  
is yours for the  
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# Brookfield

ENGINEERING LABORATORIES INCORPORATED  
STOUGHTON 13, MASSACHUSETTS

### FIRMS . . .

building an \$8-10 million refinery, scheduled for completion in October, 1957. The refinery will have initial capacity of 7,000 bbl./day and provisions for ultimate capacity of 13,000 bbl./day.



J. T. Baker Chemical Co. has a new research laboratory building in Phillipsburg, N. J.

Ferro Corp. has purchased Patterson Machine & Foundry Co., East Liverpool, Ohio.

Sherwin-Williams Co., Cleveland, Ohio, has established a research group to develop non-paint products associated with the paint industry.

Reichhold Chemicals, Inc. has completed a new Plasticenter at its Elizabeth, N. J., plant.

American Oil Co. has started engineering and design work for construction of a 25,000 bbl./day atmospheric and vacuum distillation unit for asphalt manufacture at its Yorktown, Va., refinery.

Shell Oil Co. plans to increase the annual capacity of its Shell Haven refinery in Thames estuary to 7.75 million tons. The new unit and related facilities, to cost about \$18.2 million, are to be completed by the end of 1958.

Continental Oil Co. has added a 3,300-bbl./day catalytic reforming unit to its Denver refinery, at an estimated cost of \$1.4 million.

Electro Metallurgical Co. has set up a By-Products Div. in Niagara Falls to sell by-products resulting from the production of ferro-alloys, metals, and calcium carbide.



**Felt Products Mfg. Co.** has started construction of combined manufacturing and office facilities in Skokie, Ill. The project will be completed in mid-1957.

**American Can Co.** has purchased Bradley Container Corp. of Maynard, Mass., manufacturer of extruded plastic tubes and bottles.

**General Petroleum Corp.** is expanding its Torrance, Calif., refinery at a cost of more than \$8 million. The estimated completion date is October, 1957.

**Richardson Co.,** Melrose Park, Ill., will complete a \$500,000 research and development laboratory by July, 1957.

**Venezuela Syndicate,** an American-owned independent oil company, has quadrupled its oil production and entered the oil exploration field in Venezuela by acquiring Talon Petroleum, C. A.

**Towmotor Corp.** has acquired Gerlinger Carrier Co. of Dallas, Ore., manufacturers of large capacity fork lift trucks and straddle type industrial trucks.

**Arner Co.,** pharmaceutical manufacturer in Buffalo, N. Y., has increased production capacity to more than 4 billion medical tablets a year.

**Harvey Machine Co.,** Torrance, Calif., has formed a new division to engineer, fabricate, and erect aluminum structures.

**Tennessee Products Pipe Line Co.** is operating a new fractionation plant and related transportation facilities at La Porte, Tex.

**National Cylinder Gas Co.** is expanding to provide an initial 70% boost in the production capacity of its electrolytic hydrogen plant in Los Angeles.

**Goodyear Tire & Rubber Co.** is building a \$1-million plant

## NEW AID TO BETTER COST CONTROL



### Shows You the Job Your Scales are Doing to Control Costs, Guard Quality

It's scale check-up time! Time to measure your scales against today's needs—make sure they're not falling short. The new Toledo Weight Fact Kit helps you look at your scales as a *weighing system*—shows you if any scales are "misfits" in capacity, application or location. It will help you detect weighing inefficiencies that drain off profits.

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## Thermo-compression provides ECONOMY and EFFICIENCY in evaporation process


In the installation shown above may be seen (right) a large Elliott thermo-compressor in vertical position, and (left) an Elliott two-stage ejector serving a condenser.

Thermo-compression as applied to evaporators is an arrangement wherein vapors discharged from an evaporator effect are captured and compressed to higher pressure and temperature for re-use on the hot side of the heating surface.

This is accomplished by the use of a thermo-compressor, using the energy of the boiler steam supplied to the evaporator, to entrain and compress the low-pressure spent steam, for re-use in the same body or effect. A thermo-compressor is similar to and operates on the same principle as the steam jet ejector; pressure levels are dictated by the design of the particular evaporator.

The experience of the Elliott engineering staff is available to assist in investigating applications for this thermo-compression process.

Consult the nearest Elliott District Office, or write Elliott Company, Jeannette, Pa.

**ELLIOTT Company** 

G6-2

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

### FIRMS . . .

devoted to the production of tread rubber in Chehalis, Wash.

**Odessa Butadiene Co.**, Odessa, Tex., is installing a Houdry Dehydrogenation Process unit to produce 500,000 tons a year of butadiene. The unit will be completed July, 1957.

**Kennecott Copper Co.** has acquired 51% of Molybdenum Corp.'s interest in a columbian deposit at Oka, near Montreal, Canada.

**General Tire & Rubber Co.** has acquired Lawrence Process Co., of North Andover, Mass., to expand its plastics business.

**Dow Chemical Co.** bought Bay Refining Corp and Bay Pipe Line Corp., both with headquarters in Saginaw, Mich. The company will build a petro chemical plant on a 1,000-acre site adjacent to the Bay Refining facilities at Bay City, Mich.

**Diamond Alkali Co.** is expanding the capacity of its Deer Park, Tex., chemical plant. The project is designed to boost present daily capacity of electrolytic products by about 40%.

**Procter & Gamble Co.**, Green Bay, Wis., will broaden its product line by acquiring Charmin Paper Mills, Inc.

**Sylvania Electric Products, Inc.** is building an engineering and pilot production building for its Tungsten & Chemical Div. in Towanda, Pa.

**Abbott Laboratories** is building a \$500,000 chemical manufacturing building which will increase the capacity of its bulk chemical plant at North Chicago by 20%.

**Cosden Petroleum Corp.**, Big Spring, Tex., has purchased the refinery properties of Onyx Refining Co.

**Pennsalt Chemicals** has nearly doubled the size of its plant



at Chicago Heights, Ill., a unit of its chemical specialties division.

**Imperial Chemical Industries'** plastics division has opened technical service laboratories at Welwyn Garden City, near London.

**Hooker Electrochemical Co.** has completed a \$5-million plant for output of plastic molding compounds at Kenton, Ohio.

**Ford Motor Co.** is installing fourteen gigantic field-erected aluminum reverberatory type furnaces to handle the annual contemplated requirements of 64 million lbs. of aluminum at its permanent mold and die casting plant in Sheffield, Ala.

**Budd Co., Philadelphia,** has the first commercial facility in this country which will be able to fabricate radioisotopes in strengths up to 10,000 curies.

**Electrochemical Industries (Frutarom) Ltd.** in Israel is producing hydrochloric acid at its \$3-million factory which was opened in April of this year.

**Southern Nitrogen Co., Savannah, Ga.,** has set up a technical department which will manufacture fertilizer chemicals.

**Midwest Research Institute,** Kansas City, Mo., has acquired a garden-variety greenhouse which is an important part of a system developed for studying the contribution of the automobile to the smog problem.

**Du Pont Co.** is building a \$500,000 addition to its recently completed elastomers laboratory at the Chestnut Run site, Wilmington, Del.

**Badger Mfg. Co. of Cambridge, Mass.** has opened a new office in Houston.

**Koppers Co.** has joined G. Kenneth Klose, a Central American businessman, in

# Impervite

IMPERVIOUS GRAPHITE

**CORROSION PROOF  
PROCESSING  
EQUIPMENT**

IMPERVITE equipment is unaffected by the action of all corrosives except a few highly oxidizing agents. This material provides excellent thermal conductivity (5 times that of stainless) and is immune to effects of thermal shock. For new equipment or replacements, consider the following facts: Original cost of IMPERVITE equipment is surprisingly low because of a high degree of standardization. Operating efficiency is of the highest level, and impervious graphite normally will provide a longer service life than any other material of construction.

## TUBE & SHELL HEAT EXCHANGERS

Standard components are carried in stock for quick delivery of most IMPERVITE Tube and Shell exchangers from 7 to 650 tubes in 9 and 12 foot lengths. All normal tube and shell design features are available as standard. Custom designs are furnished on order.

## CUBICAL HEAT EXCHANGERS

... provide maximum transfer surface in minimum space ... and only Falls Industries offers a complete, standardized line of CUBICAL exchangers to meet most requirements. This design accommodates operating pressures in the 150 psi range.

## CROSS-BORE\* HEAT EXCHANGERS

Featuring a rugged, heavy-duty, one-piece bundle, CROSS-BORE exchangers are furnished in standard, single and multi-pass models for heat transfer areas to 187 square feet. CROSS-BORE exchangers are especially easy to clean, and withstand operating pressures in the 150-200 psi range.

## CASCADE COOLERS

IMPERVITE Cascade Coolers feature low-pressure-dropells and flush nozzles. As standard models they are furnished in 5 tube sizes, and three different models.

## CENTRIFUGAL PUMPS\*

Outstanding service is afforded by the Falls' designed seal, which is virtually leak-proof. Standard IMPERVITE pump models are furnished up to 200 gpm, 100 ft. head, and specials are available in the range of 1000 gpm.

## RUPTURE DISKS\*

... a new idea in frangibles from Falls ... expendable and economical. IMPERVITE Rupture Disks are standard for 150# flanges, temperature to 300° F., 5% accuracy, diameters from 2" to 12". Specials are furnished to 30" diameter, to 250 psi burst, to 700° F. temperature.

ALL IMPERVITE EQUIPMENT IS PRODUCED COMPLETELY WITHIN THE FALLS INDUSTRIES ORGANIZATION UNDER THE CLOSE CONTROL OF CHEMICAL ENGINEERS.

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| <input type="checkbox"/> TUBE & SHELL    | <input type="checkbox"/> VALVES              |
| <input type="checkbox"/> CASCADE COOLERS | <input type="checkbox"/> TOWERS              |
| <input type="checkbox"/> HCL ABSORBERS   | <input type="checkbox"/> PLATE HEATERS       |
| <input type="checkbox"/> PUMPS           | <input type="checkbox"/> RAYONET HEATERS     |
| <input type="checkbox"/> RUPTURE DISKS   | <input type="checkbox"/> MACHINED COMPONENTS |



\*EXCLUSIVE FALLS INDUSTRIES DESIGN

*Falls Industries Inc.*

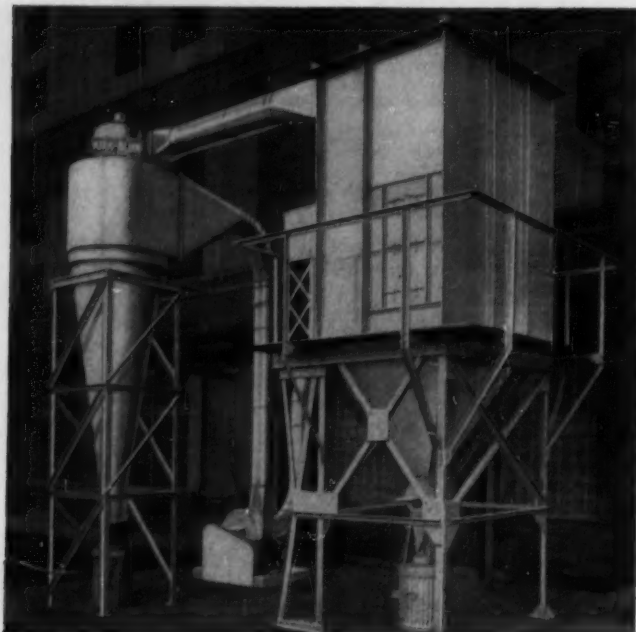
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Two-stage air cleaning: high efficiency centrifugal collector (at left) plus cloth media filter.



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To insure, in all manufacturing steps, the purity of The Wm. S. Merrell Company's products, Kirk & Blum Dust Control Systems were installed by this well known pharmaceutical manufacturer. Dust is eliminated at its source to meet the plant's strict requirements. Since the building is air conditioned, cleaned air is tempered (warmed or cooled) before it is returned to the plant.

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THE KIRK AND BLUM MANUFACTURING COMPANY  
 3208 FORRER STREET CINCINNATI 9, OHIO

**FIRMS . . .**

organizing Impregnadores de Madera de Guatemala, S. A., a new company to build and operate the first wood treating plant in Guatemala. The plant will be near the town of Gualan in the Montagua River Valley.

**Kennecott Copper Co.** of New York is building a pilot plant to produce zirconium in the Cleveland area.

**Atlantic Refining Co.**, Philadelphia, has discovered a new method for synthesizing gasoline by the use of atomic energy.

**Stauffer Chemical Co.** is building a major plant to produce titanium tetrachloride at Ashtabula, Ohio. The plant is scheduled for completion late in 1957.

**Kaiser Aluminum & Chemical Corp.** has a new \$5-million basic refractories plant at Columbiana, Ohio.

**Kaiser Aluminum & Chemical Corp.** has purchased the Government's aluminum forging plant at Erie, Pa., and is planning a \$5-million expansion there.

**Kaiser Aluminum & Chemical Corp.** will add extensive facilities for production of aluminum plate to the sheet and foil rolling mill at Ravenswood, W. Va.

**Reynolds Metals Co.** has acquired 1,500 acres of land near Massena, N. Y., for a proposed aluminum reduction plant which will cost about \$100-million.

**A. R. Maas Chemical Co.**, South Gate, Calif., is the first Western producer of commercial quantities of potassium phosphate.

**Dow Chemical Co.** is expanding its production capacity of caustic potash at its Pittsburgh, Calif., plant.

**Fluor Corp.** is constructing a \$1-million catalytic desulfurization unit at Great North-



ern Oil Co. refinery at Pine Bend, Minn.

**Anglo-Newfoundland Development Co., Ltd.**, is building a \$60-million pulp and paper mill near Sioux Lookout, Ont.

**General Electric Co's** medium induction motor department is investing \$1.5-million in a new developmental laboratory in Schenectady, N. Y.

#### NEW LOCATIONS

**Norden-Ketay Corp.** has moved its executive offices to Stamford, Conn. A central research laboratory for missile work will also be located at the site.

**Stein Hall Ltd.** has moved its Montreal branch to 8230 Mayrand Ave.

**Link-Belt Co.** has moved its Cleveland office to larger quarters at 3592 Lee Rd.

**Archer-Daniels-Midland Co.** has moved its chemical products division headquarters from Cleveland to Minneapolis.

**Faesy & Besthoff, Inc.**, manufacturer of garden and home agricultural chemicals and distributor of industrial and farm chemicals, has moved its offices to 25 East 26th St., New York.

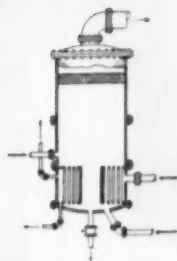
**Permatex Co.** has moved its administrative departments to 300 Broadway, Huntington Sta., N. Y.

**Servomechanisms, Inc.**, has moved its executive offices to 445 Park Ave., New York.

**Allied Chemical & Dye Corp.** has moved its National Aniline Div.'s Chicago office to the Merchandise Mart.

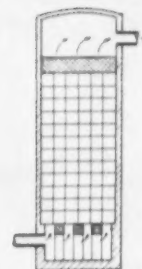
**Dow Chemical Co.** has transferred the mining and metallurgical laboratories of its technical service and development group from Pittsburg, Calif., to Midland, Mich.

## For Complete Liquid-Vapor Separation Use METEX Mist Eliminators!



#### in VERTICAL TUBE EVAPORATORS

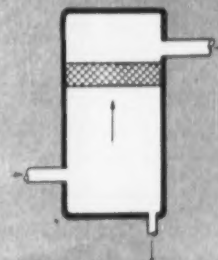
100% removal efficiency at all normal vapor velocities traps entrained contaminants below gas outlet — prevents carry-over of undesirable liquid particles.



#### in PACKED COLUMNS

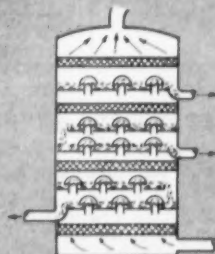
Liquid particles, rising through the packing, are effectively trapped and returned by a METEX Mist Eliminator installed at the top of the column below the gas outlet.

METEX Mist Eliminators are recommended for use in all liquid-gas processing vessels to remove and return all entrained liquids with virtually 100% efficiency over a broad range of operating velocities. High, free volume assures negligible pressure drop, usually less than  $\frac{1}{2}$ " of water. Modified knitted wire structure minimizes stagnation points for liquid build-up and assures rapid and complete drainage, even when solids are present.



#### in KNOCK-OUT DRUMS

Existing vessels can be operated at higher velocities with complete liquid removal. New vessels can be made smaller and will handle larger input.



#### in DISTILLATION COLUMNS

Used in fractionating columns, METEX Mist Eliminator can be placed above the feed inlet to remove and return impurities, or at any point of product removal where entrainment is critical for quality control.

METEX Mist Eliminators can be supplied in any required size or shape and can be fabricated of any desired metal or alloy (including some plastics) to resist varied corrosive conditions. Our engineers will be glad to recommend the type of Mist Eliminator and method of installation best suited to your individual operating conditions.

For complete information on METEX Mist Eliminators, write for Bulletin No. ME-6.



#### METAL TEXTILE CORPORATION

ROSELLE, NEW JERSEY

METAL TEXTILE CORP. or Canada, Ltd., Hamilton, Ontario

REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD



# CORPORATION BRIEFS



## TEFLON AND KEL-F INCREASE RANGE OF VANTON PUMPS

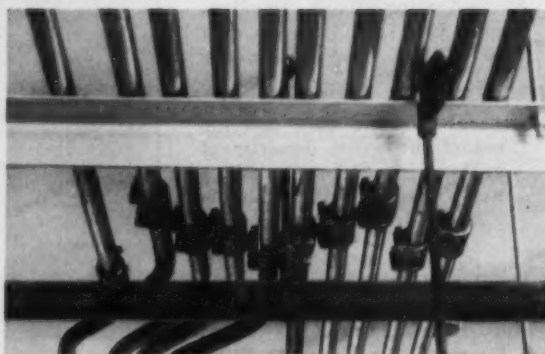


Cut-away view of pump—  
Arrow shows fluid passage

The Vanton Pump & Equipment Corp. has recently announced a pump wherein both the block and liner are furnished in fluorocarbon materials which resist most corrosives at temperatures up to 300°F.

Since the pump design eliminates shaft seals and stuffing boxes, materials pumped are isolated in a passage formed by the outer surface of a Kel-F flex-i-liner and the inner surface of a Teflon or Kel-F housing. An eccentric shaft and rotor assembly rotates within the liner and progressively "squeezees" the fluid about its outer surface.

For further information, a note on your company letterhead will bring it by return mail.



Overhead section of Quikupl couplings—  
note closeness between fittings

## QUIKUPL® FITTINGS FOR FAST EASY SET UP

A large manufacturer of toiletries recently faced the problem of setting up a 1300 ft. installation of 1" stainless steel pipe over a two-day weekend. These lines, carrying alcohol, were mostly overhead and had many take-off points to valves, tanks and pumps.

Standard threaded and welded fittings figured to take too much time and would cut into the normal weekday work schedule.

Using Quikupl® fittings with O.D. tubing, two men set up the entire line in less than eight hours. With Quikupl no threading, welding or flaring is required—only to tighten with an Allen wrench.

For further information on these unique patented fittings—write for Bulletin Q100B.

## STAINLESS STEEL DEFIBERING BLADES



The previous method used for manufacturing these blades used in the pulp and paper industry, was to machine them entirely from bar stock. They required a smooth finish with no defects and sharp clean edges. Dimensional accuracy to within  $\pm .005$  in. was specified on many important points.

How Cooper Alloy Advanced Know-How is producing these by the Shellcast® process and controlled conditions, at a cost to the customer of 50% less than that of the prior method, is told fully in AKH#5.



**COOPER ALLOY**  
CORPORATION • HILLSIDE, N.J.

Divisions:



FOUNDRY PRODUCTS DIVISION



VALVE & FITTING DIVISION



VANTON PUMP & EQUIPMENT CORP.

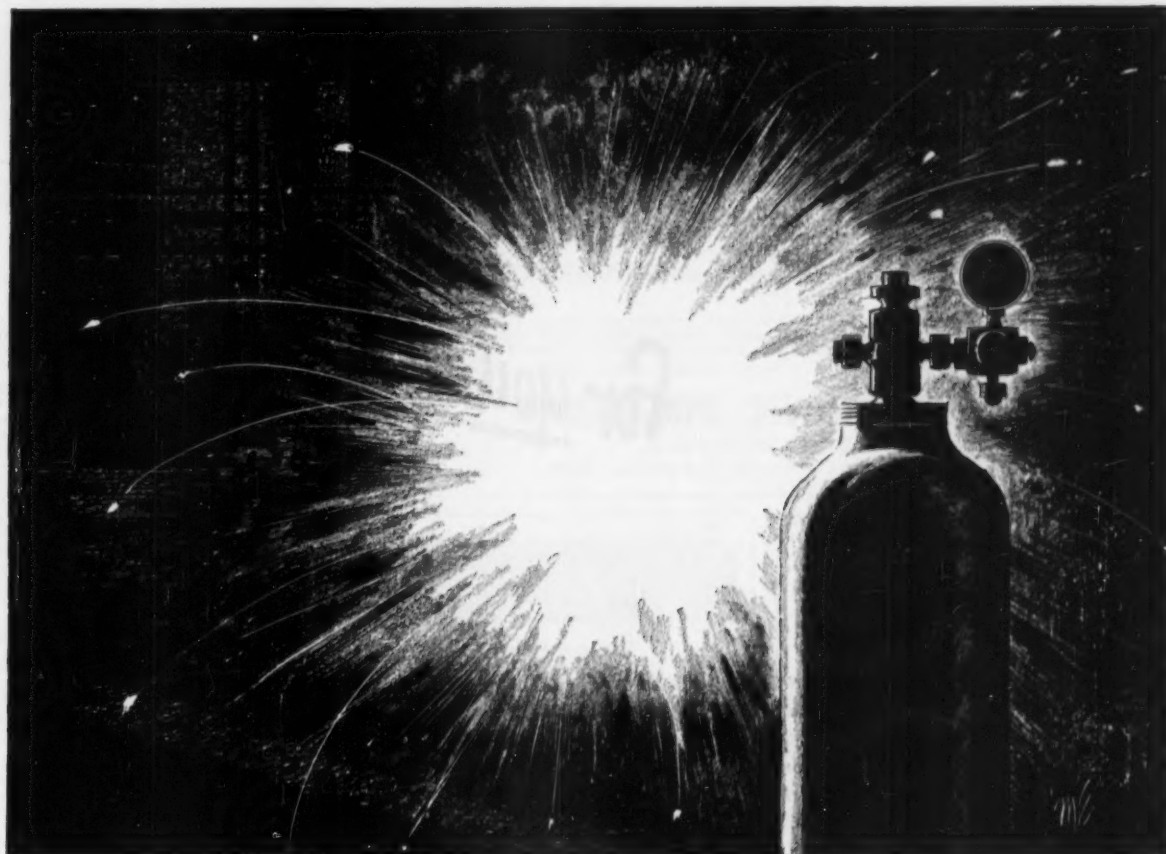


STAINLESS ENGINEERING AND MACHINE WORKS DIVISION



AIRCRAFT PRODUCTS DIVISION





## Runaway corrosion by fluorine now checked by Monel and Inconel even at high temperatures and pressures

Chemical and petroleum processors handle fluorine today with comparative ease and safety.

Even at pressures as high as 800 psi, or at temperatures well over 1000°F, spontaneous ignition by elemental fluorine and the "slow burn" of corrosion by its compounds is being held in check.

### High nickel alloys provide check rein

Monel® nickel-copper and Inconel® nickel-chromium alloys, it has been found, resist attack by fluorine over a wider range of pressures and temperatures than other commonly used construction materials.

In addition, they have excellent physical properties and are easily worked and welded.

### At moderate temperatures . . . in aqueous systems . . . Monel is used

Up to about 900°F, Monel alloy shows good resistance to fluorine. It also resists liquid fluorine, hydrofluoric acid, anhydrous HF, HF-steam mixtures and active fluorides.

Currently, Monel alloy is widely used in nuclear fuel separation and HF alkylation processes . . . for fluorine generation cells, heat exchangers, scrubbers, process piping, control instruments and other equipment.

### When temperatures go up . . . Inconel

Inconel alloy also provides high resistance to fluorine and other corrosives plus outstanding resistance to heat and thermal shock. A typical

use is in the furnaces where anhydrous HF is reacted with uranium oxide to produce uranium tetrafluoride.

\*Registered trademark

### Pamphlets summarize new technology

Three helpful pamphlets, "Fluorine Corrosion," "Industrial Handling of Fluorine" and "Continuous Disposal of Fluorine," summarize recent developments in fluorine control. Write for copies. And for help in solving your specific corrosion problems, write to Inco's Development and Research Division.

The International Nickel Company, Inc.  
67 Wall Street New York 5, N. Y.



**NICKEL ALLOYS...Protection Against Fluorine**





he's working  
for you

THIS FELLOW IS TRAINED IN YOUR BUSINESS. His main duty is to travel the country — and world — penetrating the plants, laboratories and management councils . . . reporting back to you every significant innovation in technology, selling tactics, management strategy. He functions as your all-seeing, all-hearing, all-reporting business communications system.

THE MAN WE MEAN IS A COMPOSITE of the editorial staff of this magazine. For, obviously, no one individual could ever accomplish such a vast business news job. It's the result of many qualified men of diversified and specialized talents.

AND, THERE'S ANOTHER SIDE TO THIS "COMPOSITE MAN," another complete news service which complements the editorial section of this magazine — the advertising pages. It's been said that in a business publication the editorial pages tell "how they do it" — "they" being all the industry's front line of innovators and improvers — and the advertising pages tell "with what." Each issue unfolds an industrial exposition before you — giving a ready panorama of up-to-date tools, materials, equipment.

SUCH A "MAN" IS ON YOUR PAYROLL. Be sure to "listen" regularly and carefully to the practical business information he gathers.



McGRAW-HILL PUBLICATIONS

## WHERE TO BUY

Featuring additional Equipment, Materials, Supplies & Services for the Process Industry



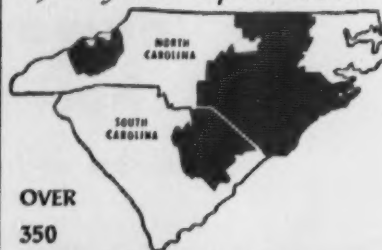
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## THE RIGHT LOCATION

for your operation



OVER

350

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Area Development Dept.)

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### Make it a habit

To check, each issue, the announcements appearing in this  
**WHERE TO BUY SECTION**  
They supplement other advertising in  
**CHEMICAL ENGINEERING** of products  
and services essential to modern chemical plant operation



## PUMP ACCOUNT WANTED

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Aggressive Pump Sales Engineers  
In New York City Area  
RA-3302 CHEMICAL ENGINEERING  
Class. Adv. Div. P.O. Box 12, N. Y. 36, N. Y.

REPLIES (Box No.): Address to office nearest you  
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Mechanical Engineers or Chem. Engineers recent grads train U. S. then overseas assignments open. Edwards Employment Agencies, Inc., Executives-Engineers 73 Warren St., New York 17, N. Y.

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Chemical Engineer: M. S., 14 years experience in heavy chemicals, explosives, research and development, instrumentation, teaching, pipeline design, natural gas work, and administration. Desires opportunity to use training and experience in a position of growth potential. PW-3428, Chemical Engineering.

Chemist B. S. Engineering experience. Desires Latin American assignment. 14 years experience process development, pilot plant and production. Pharmaceutical and heavy chemicals. Family. PW-3408, Chemical Engineering.

## NEW ADVERTISEMENTS

received by December 13th will appear in the January issue subject to space limitations.

Classified Advertising Division

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Chem. Engineer, Dr. Ing., Dipl. Chem (corr. to Dr. Ch. E.), excellent German diploma; 15 years experience, organic and metal-org. synthesis; paint and lacquer industry; actually prof. or org. chem. and Thermo-dynamics in South America; proficiency of Spanish and German languages, English sufficient—wants respons. position in U.S.A. Research on organic field or foreign service in Latin America preferred. PW-3323, Chemical Engineering.

SEE CHEMSTRAND'S AD on Page 36 of THIS MAGAZINE

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Permanent position with national concern for industrial or mechanical staff engineer to assist and advise the management of several food plants and feed mills. Experience in food or feed industry desirable. Location—Middle West. Please furnish complete resume of qualifications and initial salary requirements. Replies held in confidence.

P-3292, Chemical Engineering  
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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To provide for its continued growth Chemical Week is seeking two additional assistant editors—preferably chemists or chemical engineers with two to three years business experience. Essential: Ability to meet people, dig out facts, interpret them intelligently and write lucidly. Please submit resume to:

PERSONNEL DIRECTOR  
McGraw-Hill Publishing Co.  
330 W. 42ND ST.  
NEW YORK 36, N. Y.





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#### MOVING EXPENSES PAID

Replies held in strictest confidence, all will be answered. Please send complete resume to Mr. D. M. Duguid, Technical Employment Manager, Texas Division, Dow Chemical Company, Freeport, Texas or for personal interview call:

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AIChE Meeting December 10, 11, 12

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Salaries open—plus unusual incentive plan. Attractive New England location. Travel expenses paid for men selected for personal interview. All replies confidential. Please send outline of experience to

P-3498, Chemical Engineering  
Class. Adv. Div., P.O. Box 15, N.Y. 36, N.Y.

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One of the fastest-growing companies in the chemical industry, manufacturing heavy and fine chemicals, and plastics, requires engineers for process engineering. Work consists of plant, pilot plant and laboratory work in connection with process improvement, efficiency, quality, and equipment evaluation studies of existing plant processes. One to four years' experience desirable but not necessary. Opportunity to obtain broad experience in technical problems of diversified chemical manufacture. Salary commensurate with experience. Apply Industrial Relations Dept.

Hooker Electrochemical Co.  
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- PROJECT ENGINEERS
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Experienced in, or interested in, Heat Transfer, Chemical or Mechanical engineering degrees or equivalent experience required. Midwest location.

Salary Commensurate with Ability

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P-3260, Chemical Engineering,  
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### At Your Service . . .

The Searchlights Section is at your service to bring business needs or "opportunities" to the attention of men in executive, management, sales and responsible technical, engineering and operating capacities with the industry served by this publication.



## ENGINEERING SALES

Are you interested in a sales engineering career in the field of instrumentation and automation? We are looking for qualified engineering graduates, preferably chemical or electrical, between 25 and 35 years of age, with a few years' experience in instrumentation or engineering sales, for location in Boston area; Buffalo; Syracuse; Greenville, S. C.; Chicago; Tulsa; Houston; and Los Angeles.

Applicants must be willing to relocate and travel adjacent territory. Car furnished, salary and expenses, fringe benefits. Sales aptitude test furnished at our expense, plus thorough training course at home office (Foxboro, Massachusetts) for successful applicants.

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J. J. BURNETT  
Field Sales Manager

### THE FOXBORO COMPANY

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Diamond Alkali Company  
300 Union Commerce Building  
Cleveland 14, Ohio

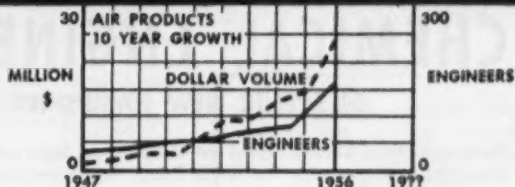
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Personnel Dept.

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Openings are available in Process Design, Project Engineering, Estimating and Economic Evaluation, Equipment Design, Sales Engineering, Manufacturing Engineering, Supervision of Oxygen Plant Operations and other areas for which you might be qualified. To arrange confidential interview, send resume to Technical Personnel Manager.

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We also need engineers who are interested in applying the principals of thermo dynamics, fluid flow, heat and mass transfer, vapor-liquid equilibria, etc. to the solution of complex new problems in low temperature technology including distillation, adsorption, absorption, physical property experimentation, analytical methods and instrumentation, process development, pilot plants, equipment development including process apparatus and machinery items such as turbines, pumps, expanders, compressors and many other interesting and classified projects.

Interviews can be arranged at AIChE annual meeting Boston, December 9th through 12th. Contact B.H. Van Dyke December 11 or 12 at Convention headquarters.

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If you are a chemical engineer looking for real and continuing opportunities—not just a position—but a career in

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- Production Supervision
- Technical Sales

You will be interested in learning more about

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If you plan to be in Boston for the American Institute of Chemical Engineers meeting Dec. 9 to Dec. 12

Call C. H. WENDEL, Trowbridge 6-1400  
to get further information

If you are not coming to the meeting, write to the Industrial Relations Dept.

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P-3446, Chemical Engineering  
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### Chemical or Metallurgical Engineer

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P-3396, Chemical Engineering  
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2. PURCHASING STANDARDS COORDINATOR—Ch.E. or M.E., with several years' experience, capable of handling a new purchasing standardization program.
3. ASSISTANT GENERAL PURCHASING AGENT FOR RAW MATERIALS—Chemist or Ch.E. Extensive industrial experience in procurement of chemical raw materials desired.
4. ASSISTANT PURCHASING RESEARCH ANALYST—Degree in Economics, Stats., Math., or Chemistry. Several years' research experience in chemical or allied fields desired.

All applicants must have proved administrative ability and be capable in coordinating relative functions between departments.

Excellent company benefits and working conditions. Send complete resume and state salary desired.

P-3414, Chemical Engineering  
Class Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

## CHEMICAL ENGINEER

Assistant Area Supervisor needed with experience in Ammonia and Methanol. 28-35 years of age.

Expanding chemical plant in Texas, close to large metropolitan area.

Challenging job and excellent living conditions.

Salary commensurate with experience.

Reply to P-3468 Chemical Engineering  
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## CHEMISTS

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Of Chemical Engineering published monthly at Albany, New York for October 1, 1956.

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Sworn to and subscribed before me this 14th day of September, 1956.  
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(My Commission expires March 30, 1957)



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- 1—Al. Ch. 6' D x 16' L Steel Lined Contin. Ball Mill Granulator
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- 3—Sprout Waldron size 12 Ribbon Mixers, 336 cu. ft. work. cap.
- 1—W & P Sigma Blade Double Arm Jacketed Mixers, 50 gal. & 100 gal. work. cap.
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- 3—New Simpson model, intensive mixers, 5 Hp TEFC
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- 5—Double drum dryers 6 x 8", 24 x 48", 32 x 52", 42 x 100"
- 1—Fitzpatrick S/S model K comminuting machine
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 4—Centrifugals 12", 30", 40" & 48" Steel, Copper, Stainless & Rubber Lined.  
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 1—Dopp 350 gal. C. I. Jack. Vac. Kettle.  
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 Devine 1000 gal. closed Jack. Steel Kettle.  
 1—2300 gal. Vert. agit. Jack. Steel Kettle.  
 8—Jacketed Kettles 50 to 2300 gals.  
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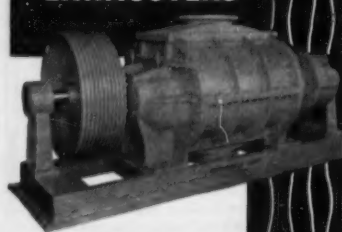
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 1—Schutz O'Neil 20" Pulverizers. Also #1.  
 Williams 223 & 2xx Hammer Mills.  
 1—Robinson 18" & 22" Attrition Mill.  
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 1—Raymond 6" Hammer Mill, like new.  
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- 1—AT&M Suspended Type Centrifuge with 18" Stainless steel perforated basket, complete.
- 3—Sharples Stainless Steel Super-Pre-surite Centrifuge Model 16Y.
- 1—DeLaval Type 316 Stainless Steel Multitatic Centrifuge.
- 1—Baker Perkins Ter Meer Type 316 Centrifugal, Model HS-24.

**DRYERS & KILNS:**

- 1—Stokes Rotary Vacuum Dryer, 30"x12'.
- 1—Hardinge Rotary Dryer, 7'6"x55'.
- 2—Rotary Kilns, 7'6"x60'.
- 1—Bartlett & Snow Rotary Dryer 4'6"x36'6".
- 1—Stokes Double Drum Dryer, 5'x12', ASME code.
- 1—Bullovak Double Drum Dryer, 42"x120', ASME code.
- 1—Link Belt Roto Louvre Dryer, Model 502-20.

1—Sharples Type 316 Stainless Steel Super Dehydrator, Model C20

1—Stokes Model R Tablet Machine with Variable Speed Drive, 3 HP motor.

1—Pfaudler 1400 gallon Glass-lined Jacketed Reactor, 30# internal, 40# Jacket.

1—Sparkler Type 316 Stainless Steel Filter, Model 33517.

1—Link Belt Stainless Steel Roto Louvre Dryer, Model #207-14.

1—Link Belt Roto Louvre Dryer, 11'6" x 36'.

1—Link Belt Roto Louvre Dryer, Model 310-16.

1—Link Belt Roto Louvre Dryer, Model 502-20.

1—Oliver Stainless Steel Rotary Precoat Filter, 3' x 6' (New).

4—Tolhurst Suspended Type Centrifuge with 30" Imperforated basket, complete.

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- 1—Republic 15" Flexmaster Stainless Steel Filter, 15 chambers.
- 2—Ertel Stainless Steel Filters, 12", 20 leaves.
- 1—Oliver Rotary Vacuum Filter, Rubber-lined, 3'x6'.
- 10—Sparkler and Shriver Cast Iron Filter Presses, 12" to 42".
- 2—Alsop Type 316 Stainless Steel Filters, Size SD 12 WR-20.

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- 1—Vulcan Steel Bubble Cap Column, 18"x25', 17 trays, ASME (New).
- 1—Vulcan Steel Bubble Cap Column, 42"x30', 20 trays, ASME (New).
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December 1956

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• Your complete index to chemicals, materials, equipment and services taken from this issue's advertisements, new products departments and "Guide to Technical Literature."  
• Products listed feature code numbers which show the page on which they appear. L (left), R (right), T (top), B (bottom) indicate ad location; A, B, C, etc. and a, b, c, etc. identify specific product items on an editorial page or in an ad.  
• You can get information on any listings by circling its key number on the Reader Service Postcard (see inside back cover). Replies will come direct from the companies manufacturing the products.

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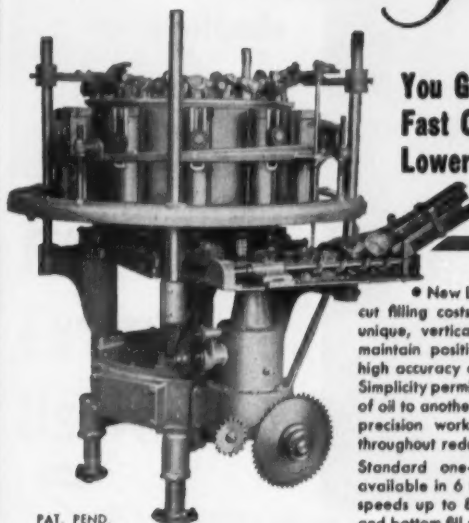
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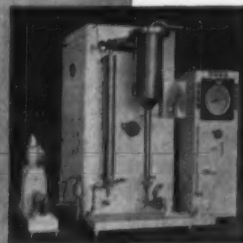
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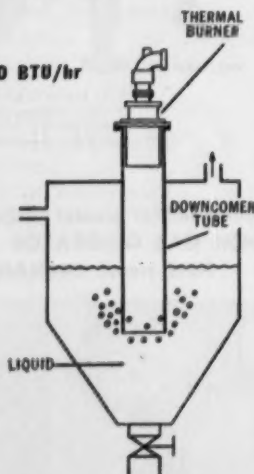
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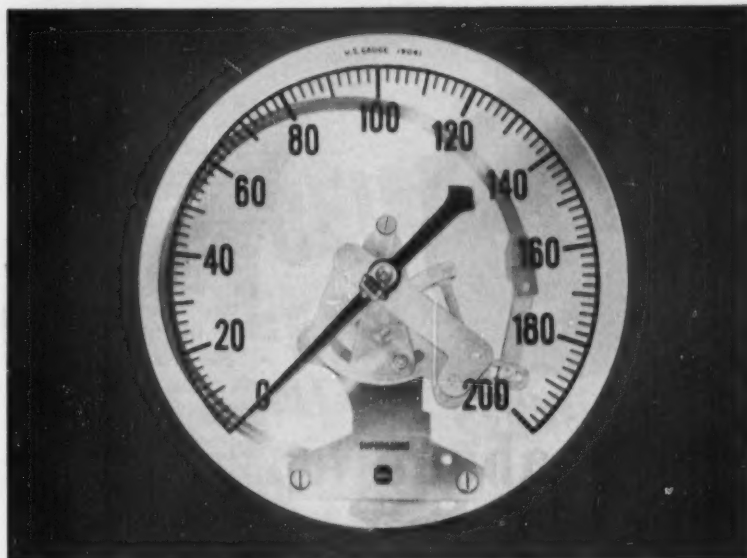
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## New Supergauge Movement Extends Gauge Life; Gives Users Many Extra Benefits

In the quest for longer gauge life under severe operating conditions, one of the principal hurdles confronting instrument engineers has been the problem of gear tooth wear. Many efforts have been made to solve this problem including the use of materials other than metal.

U. S. Gauge research indicated nylon rolling on stainless steel provided the best solution if proper control of the nylon were achieved. All past experience showed that expansion of the nylon when subjected to heat and humidity changed pitch diameter causing binding and wear. This destroyed the gear rolling action, thus defeating its main advantage of assuring longer gauge life under severe operating conditions.

Using a new approach to the problem, U. S. Gauge engineers developed the new \*ARC-LOC movement.

Molded nylon is bonded to the face of the stainless steel segment to maintain pitch diameter. Gear teeth are then accurately generated on the nylon face to assure perfect rolling action on the stainless steel pinion. The segment gear face is broad and all bushings or pivots are deep to assure strength and ruggedness. The result is longer gauge life under severe operating conditions.

Since nylon is applied to the arc of the sector, any tendency of the nylon to grow or shrink occurs along the periphery instead of along the radius. Thus, accurate pitch diameter is maintained and there is no wear from binding. With this design, the smooth gear rolling action between segment and pinion continues even under adverse conditions of heat and humidity.

The new U. S. Gauge ARC-LOC movement also provides several additional features of interest to the user: For easier adjustment the complete movement can be rotated about the pinion axis, positioned properly and locked from the rear. This provides the advantage of linearity adjustment without removing dial and pointer. The unique locking method also eliminates creep during locking.

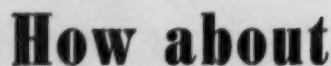
The Arc-tang segment allows range adjustment without resetting of the pointer.

These added advantages mean savings in time during calibration... an important factor in maintenance reduction.

For complete information on the savings that are made possible by U. S. Gauge's new Supergauges and Solfrunt gauges with the new ARC-LOC movement, write for Publication 1819.

  
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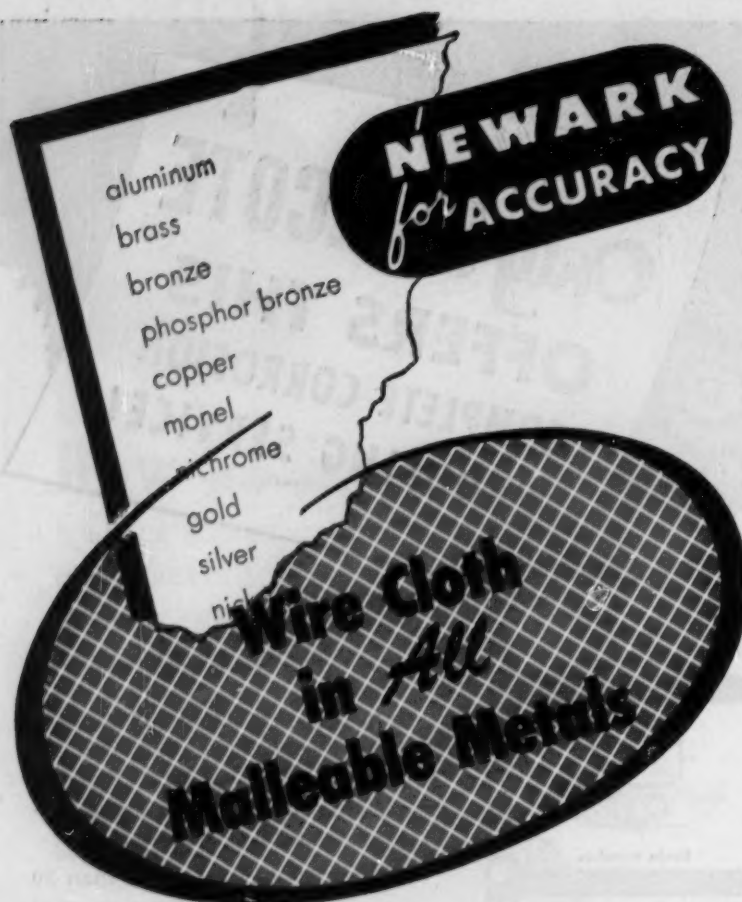
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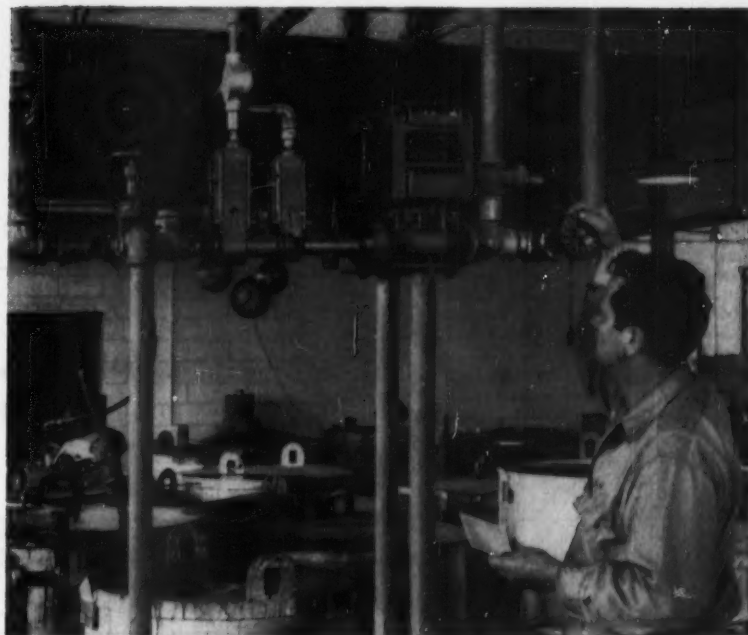
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**Chemicals**.....Bulletin covers the Morn-ingstar-Paisley family of related products—starches, dextrans, adhesives, chemical products. Gives good perspective of rapidly developing field of liquid adhesives.  
450L Paisley Products

**Chemicals**.....1957 Edition Physical Properties covers acids, alcohols and esters, aldehydes, aryl and pyridine-type compounds, aliphatic nitrogen compounds and others. For details, request Bulletin F-6136J.  
450M Carbide & Carbon Chem.

**Chemicals**.....Article by A. T. Loeffler highlights vital role of chemical science and industry in National Defense. Outlines the part FMC Chemical Divisions play in the chemical life of the nation.  
450N Food Machy. & Chem. Corp.

**Chemicals**.....Products Catalog covers agriculture and horticultural fungicides, food and beverage chemicals, industrial fungicides, intermediates, stearates, pharmaceuticals, foam and wetting agents.  
450O B. L. Lemke & Co.

**Colors, Polyethylene**.....Bulletin describes Stan-Tone GPE (granular polyethylene) Colors. Colors are compatible with polyethylene, vinyl & rubber. Includes color composition. Bulletin No. 02-134-2-6-56.  
450P Harwick Standard Chem. Co.

**Defoamers, Silicone**.....Defoamers have proved their efficiency and versatility in countless applications. Offers a new booklet with complete information on Dow Corning Antifoam agents plus a product sample.  
L463 \*Dow-Corning Corp.

**Diatomaceous Silica**.....46 p. booklet, "Flattening Agents, Pigment Extenders, Filter Aids for the Finishes Industry" contains 41 paint formulas collected from various raw material manufacturers. Request your copy.  
450Q Johns-Manville.

**Dimethyl Hydantoin**.....4 p. bulletin gives physical properties and chemical reactions of DMH. Dimethyl Hydantoin (Acetonyl Urea) is now being produced on a tonnage basis. Bulletin is available upon request.  
450R Glyco Products Co.

**Diphenylamine**.....Diphenylamine is used in the manufacture of rubber anti-oxidants, smokeless powder, dyestuffs. Other potential applications are: paper sizing, fuel additive, carotene stabilizer. Details & sample.  
450S American Cyanamid Co.

**Dispersants, Liquid**.....Bulletin gives physical properties of Surfynol TG, new liquid nonionic dispersant for emulsion paints. Gives typical formulations for polyvinyl acetate, acrylic & butadiene-styrene systems.  
450T Air Reduction Chem. Co.

**Dispersions, Carbon Black**.....New technical service bulletin describes a procedure for the direct determination of the degree of carbon black dispersion in polyethylene master-batches. Request your copy.  
450U Godfrey L. Cabot, Inc.

**Ethanolamines**.....Two plants—South Charleston, West Virginia and Seadrift—will supply you with ethanolamines. "Nitrogen Compounds" discusses applications, physical properties, and specifications for ethanolamines.  
145 \*Carbide & Carbon Chem.

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\* From advertisement, this issue



**Ethers & Oxides**.....Ethers & oxides for chemical syntheses, extraction processes, photographic films, smokeless powder, insecticides, industrial fumigants, denaturants, reaction media. Bulletin F-4764A.  
451A Carbide & Carbon Chem.

**Ethylene Oxide**.....8 p. brochure describes process developed for the production of ethylene oxide by the direct air oxidation of ethylene. A complete flow diagram is presented. Copies available upon request.  
451B Scientific Design Co.

**Flocculating Agent**.....Two technical manuals describe uses for Separan 2610, high speed flocculating agent . . . "Separan 2610 in the Pulp and Paper Industry" and "Separan 2610 in the Coal Industry."  
451C Dow Chem. Co.

**Fluorocarbon Products**.....Newly published booklet covers entire family of KET-F fluorocarbon products—plastics, dispersions, oils, waxes, greases, elastomers, printing inks and chemicals. Request your copy.  
279 \*M. W. Kellogg Co.

**Formaldehyde**.....Bulletin covers product data, methods of analysis, shipping information, safe handling, materials of construction, storage and handling, uses. Supplementary bibliography will prove useful.  
451D Heyden Chem. Corp.

**Glycerine**.....19 p. booklet, "Glycerine—Terms, Tests, Technical Data," describes commercial grades, definitions, specifications, test methods, and shipping and storage requirements of glycerine.  
451E Glycerine Producers' Assoc.

**Glycol Carbonates**.....Technical information gives physical properties, solubilities, applications, chemical properties, reactions & physiological properties for several glycol carbonates. Request Bulletin F-8307.  
451F Carbide & Carbon Chem.

**Inhibitors, Corrosion**.....A discussion of the possible use of slightly soluble molybdates in white & tinted inhibitive paints. A simplified procedure for estimating the corrosion inhibition. Bulletin Ch-25.  
451G Climax Molybdenum Co.

**Inhibitors, Corrosion**.....Company offers a comparative study of corrosion inhibition by molybdates, tungstates, chromates and nitrites. Full details are made available in Bulletin Ch-24. Request your copy.  
451H Climax Molybdenum Co.

**Lithium Aluminum Hydride**.....A specific agent for numerous organic reductions. Reference gives composition, properties, solubility, applications, typical reductions, handling, safety & storage data. Bul. 401-D.  
451I Metal Hydrides.

**Lithium Compounds**....."Chemical and Physical Properties of Lithium Compounds" presents reliable information on 16 compounds of lithium. Compiled and augmented by much new data now being developed by company.  
451J Foote Mineral Co.

**2-Methyl-5-Ethyl Pyridine**.....Bulletin gives information on properties, specifications, shipping data, and applications. Also describes typical reactions of 2-methyl-5-ethyl pyridine. Bulletin F-7621.  
451K Carbide & Carbon Chem.

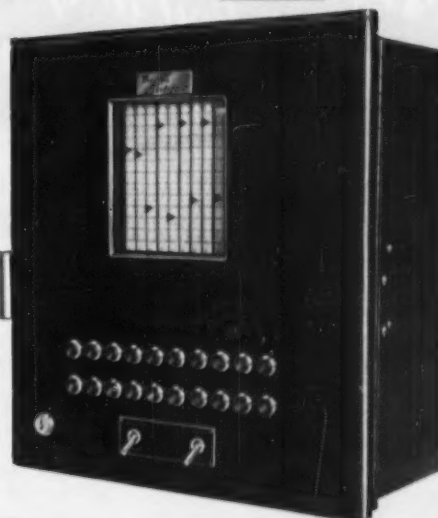
**Molybdate Orange**.....Laboratory data comparing the properties of molybdate orange & chrome orange. Includes results of test on lightfastness, hiding power, tinting strength, gloss & working properties. Bulletin Ch-22.  
451L Climax Molybdenum Co.

**Molybdenum Pigments**.....Articles on molybdenum inorganic and organic pigments. Reviews of history, properties, manufacture and uses of molybdate orange and of molybdated toners. Details in Bulletin Ch-12.  
451M Climax Molybdenum Co.

\* From advertisement, this issue

## ONE Instrument Now Controls Temperatures From MANY Points

T-E's  
New  
Multi-  
Point  
Controller



This new, Multi-Point, Pyrometer Controller now provides—in one instrument—automatic temperature control for up to ten separate process units. Alone, it handles installations that formerly required as many as ten individual instruments. Immediate advantages are obvious—a great reduction in necessary panel board space, a tremendous decrease in initial cost, much lower maintenance costs, and the time-saving convenience of setting and observing temperature controls at one location.

It applies to practically any installation suitable for two-position control action—creep test machines, multi-zone ovens and furnaces, laboratory aging and reaction vessels, batteries of batch process units, and many others. Simple adjustments permit skipping of one or more points—providing optional control of four to ten units. Control settings consist of ten separate slide wires with ten individual set points. Red and green signal lamps indicate temperature conditions for each point. Scale ranges for all calibrations run from -400° F. with C-C to +3250° F. with Plat. 30% Rh.—Plat. 6% Rh.

**Measuring Accuracy** is insured by the null balance potentiometer measuring circuit, which permits calibration independent of thermocouple and extension wire resistance. Potentiometer accuracy depends on the stability of fixed circuit resistors, not on less dependable mechanical elements.

**Operating Speed** is usually three seconds per point, 30 seconds for all 10 points. Gears for other speeds are available and easily changed in the field.

**High Sensitivity** starts corrective action after deviation from set point of only 1° F. for I-C and 1.5° F. for C-A.

Write for EDS-25-E

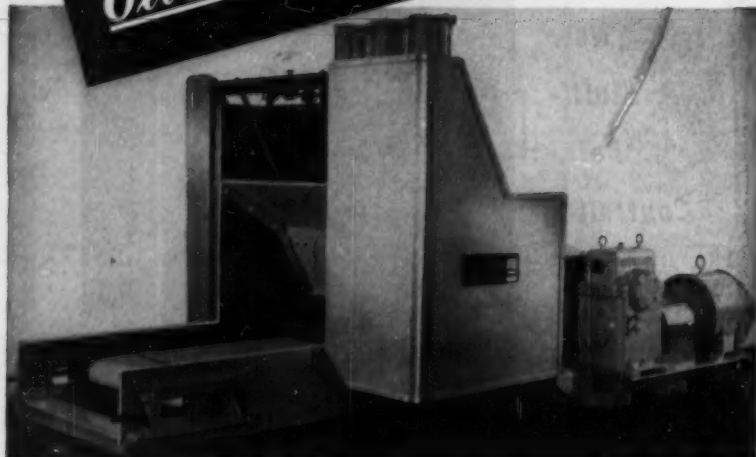
# Thermo Electric Co., Inc.

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In Canada — THERMO ELECTRIC (Canada) Ltd., Brampton, Ontario



**"NATIONAL" Has  
the Solution to Your  
Extruding Problems**



## THIS Versatile "NATIONAL" EXTRUDER

is designed to economically extrude a wide variety of materials, many of which could not previously be processed by this method, and to assure the extruded material of better form for subsequent handling.

The extruding operation incorporates a "National"—developed wiping motion that leaves the material less compact . . . ready for quicker, more efficient drying. Machines can be arranged for continuous tray loading, or for feeding to a continuous apron dryer . . . either in full-width load or to reciprocating spreader to wider apron. Variations in rate of extrusion are regulated by speed of rotor and pneumatic loading of ram.

**ANY SIZE or CAPACITY** "National" Pre-Form Extruders are available in any required size or capacity, and in any metal called for by specific conditions. They are built to the same quality specifications which distinguish all "National" Dryers . . . your guarantee of long, trouble-free service.

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### LITERATURE . . .

**Plasticizers.** . . . Up-to-date bulletin describes low temperature plasticizer, Plasticizer SC. Includes physical and chemical properties, data on use in Hycar, Chemigum, Paracril and Neoprene. Bulletin #06-72-3-5-56.  
452A Harwick Standard Chem. Co.

**Plasticizers.** . . . 48 p. bulletin lists properties and specifications of 15 plasticizers. Includes methoxyethyl, butoxyethyl, butyl and octyl esters, phthalates, adipates, stearates, oicates and laurates.  
452B Kessier Chem. Co.

**Polyethylene.** . . . Offers new 14 p. brochure describing currently available grades of low molecular weight A-C Polyethylene. Gives actual and suggested end uses for these versatile polymers. Bulletin No. 116.  
123 \*Semet-Solvay Div.

**Polyphenyl, Chlorinated.** . . . Aroclor 1248 is a highly stable chlorinated polyphenyl; does not support combustion up to its boiling range 652° to 725°F.; is non-corrosive. Request technical information.  
171a \*Monsanto Chem. Co.

**Polystyrene.** . . . "Secrets" of Commercial Polystyrene Production, outlines problems encountered, and a summary of requirements for production of today's high quality commercial polystyrene. Bulletin TSB-8-56.  
452C Koppers Co.

**Potassium Borohydride** . . . Detailed reference gives composition, properties, solubility, applications, typical reductions, handling, safety and storage information. Request copy of Technical Bulletin No. 201-B.  
452D Metal Hydrides.

**Rare Earths.** . . . Bulletin presents latest data on high purity rare earths . . . their character, their nature, separation, differences, applications, bibliography, alloys of the future. Available upon request.  
452E St. Elol Corp.

**Resins.** . . . Booklet discusses properties of BUTVAR—polyvinyl butyral—and FORMVAR—polyvinyl formal, preparation of wash primers, suggested formulations, and applications of the primer to metal.  
452F Shawinigan Resins Corp.

**Resins Geon Solution.** . . . Geon polyvinyl resins designed for resin solution application—to provide thin, economical coatings on wood, glass, metal, masonry, paper, and other materials. "Geon Solution Resins".  
12 \*B. F. Goodrich Chem. Co.

**Resins, High-Styrene.** . . . New Bulletin HY-2 describes newly developed high styrene resin—"Hystron." Contains information on processing, applications, compounding, specifications, physical properties, etc.  
452G General Tire & Rubber Co.

**Resins, Tetrafluoroethylene.** . . . Teflon tetrafluoroethylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & applications.  
239 \*E. I. du Pont de Nemours.

**Silanes, OrganoFunctional.** . . . Bulletin tells what they are, how they react, what they can do. Possible products are: lubricants, greases, emulsifiers, antistatic agents, finishing agents, etc. Bulletin SF-1055.  
452H Union Carbide & Carbon.

**Silicones.** . . . "Silicones for Industry" describes a new family of semi-organics with unusual properties . . . rubber gums & compounds, resins, fluids, emulsions, chemicals. Booklet is available upon request.  
452I General Elec. Co.

**Sodium Borohydride.** . . . MH sodium borohydride, NaBH<sub>4</sub>, will reduce esters, acids, acid anhydrides, and acid halides. Announces the availability of detailed Bulletin 502-F and typical reduction procedure.  
452J Metal Hydrides.

\* From advertisement, this issue



**Sodium Hydride**.....Makes available a detailed technical reference containing information on: composition; properties; solubility; applications; typical reductions; handling; safety; storage. Tech. Bulletin 507-C.  
455A Metal Hydrides.

**Sodium Hydride Oil Dispersion**.....Detailed reference contains information on composition, properties, solubility, applications, typical reductions, handling, safety and storage. Request Technical Bulletin No. 508-A.  
455B Metal Hydrides.

**Sodium m-Silicate**.....Valuable data on Drymet anhydrous—the most highly concentrated form of sodium m-silicate. Drymet File Folder contains complete technical information and suggested formulations.  
B468 \*Cowles Chem. Co.

**Softeners, Nonionic**.....Bulletin lists properties and test procedures for Emersoft 7700, as well as application data for use in the finishing of most cottons. For full details, see Technical Bulletin 407.  
453C Emery Industries.

**Sulfoxide**.....Sulfoxide is an effective synergist... safe... non-irritating. 12 p. bulletin, "Sulfoxide," gives technical information and suggested starting formulas for popular insecticidal spray. On request.  
453D S. B. Penick & Co.

## Construction Materials

**Adhesives, Bonding**.....Bulletin presents function, composition, properties (color, odor, toxicity, typical specific gravity, typical lbs./gal.), application. For complete details, see Bulletin 13-121-4-9-56.  
453E Harwick Standard Chem. Co.

**Aluminum**....."Alcoa Aluminum Handbook" presents data on aluminum alloys and mill products in a tabular form. Deals with wrought alloys; sheet & plate; wire, rod & bar; extrusions; tube & pipe; etc.  
453F Aluminum Co. of America.

**Castings, High Alloy**.....Covers facilities for producing high alloy static & centrifugal castings & offers data on castings used for resisting high temperatures, corrosive & abrasion. See Bulletin No. 3150-G.  
446 \*Duraloy Co.

**Ceilings**.....Bulletin describes new and complete Electra Luminus Ceiling package, made with Bakelite rigid vinyl sheet. Specially developed for light diffusion, resists color change, dust and moisture. Bulletin #9012.  
453G Bakelite Co.

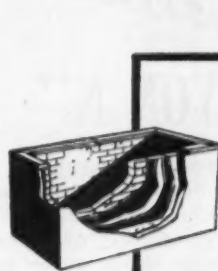
**Coatings, Aluminum**.....Company offers new folder describing a new aluminum roof coating, which insulates against heat and cold. Provides solid, durable, weather-tight protection. Request your copy.  
453H Stonhard Co.

\* From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

# plant wide protection from corrosion

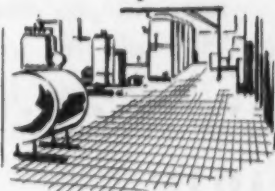


## TANKS

all types of pickling, plating, chemical processing, storage and other tanks containing corrosive chemicals are constructed of Atlas materials.

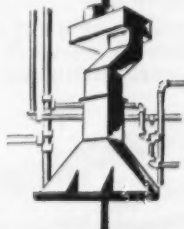
## FLOORS

industrial floors are designed to resist attack of a wide range of corrosive spillage, including acids, alkalis, solvents, salts, greases and detergents.



## HOODS, DUCTS, FUME SYSTEMS

completely resistant self-supporting rigid plastic structures are designed and fabricated to meet your specific requirements . . . complete plastic pipe systems including flanges, valves and fittings are also available.



## PLANT INTERIORS

protection of all corrodible surfaces is possible by using the proper Atlas coating . . . vessel exteriors, walls, beams, ceilings can be coated for lasting service.



Atlas provides a complete corrosion service from on-the-spot technical advice through engineering design to complete construction facilities to carry the job from beginning to end.

ATLAS PRODUCES THE MOST COMPLETE LINE OF CORROSION PROOF MATERIALS OF CONSTRUCTION AVAILABLE FROM ONE MANUFACTURER



# TOUGH JOB FILTER CLOTHS

## Now Available

### ORLON\*

Good resistance to hot mineral acids, weak alkalis, common solvents, oils, greases, neutral salts, acid salts and chlorine.

No loss of strength after 32 days exposure to air at 257°F. Negligible shrinkage.

### VINYON N\*\*

Excellent resistance to strong acids such as sulphuric, nitric, hydrochloric, hydrofluoric and aqua regia. Also to sodium and potassium hydroxide; chlorine and bromine water, silver nitrate, tannic acid and many oils, fats and waxes.

Boiling solutions are readily withstood by these versatile media.

### SARAN

Exceptional resistance to acids, particularly hydrochloric, and to alkalis except ammonium hydroxide. Unaffected by alcohols or aliphatic hydrocarbons. Continuous exposure up to 160°F. and intermittent exposure up to 212°F. do not appreciably affect tensile strength.

### GLASS

Woven from highly resistant, durable chemical glass. Usable where such synthetic itself is usable.

These cloths are available in several weaves and in standard widths ranging from 26" through 72" or made up into filter element covers. These cloths are all woven in our own mill by operators having long experience in the art of synthetic fabric weaving.

... for your filter paper requirements try NETONE Filter Paper. High tensile strength, chemical resistant, high burst factor, abrasion resistant and crease resistant. Send for a test sample.

\* TM for Du Pont Acrylic Fiber

\*\* TM—Union Carbide & Chemical Co.



Weavers of Industrial Filter Media for over Fifty Years

## The National Filter Media Corp.

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Cincinnati, Ohio: Roselawn Center Bldg.

Houston, Texas: 1503 Hodley St.  
Oslo, Norway: Nicolai Friis  
Johannesburg, South Africa: Edward L. Bateman

### LITERATURE . . .

**Coatings & Materials, Corrosion Resistant** . . . Celcote engineers have developed a wide range of corrosion-proof linings, bonding cements, bricks, flooring materials and protective coatings. See Catalog G-201.  
447 \*Celcote Co.

**Coatings, Protective** . . . Bulletin describes how good structural design aids coatings in protecting steel surfaces. Tells how to weld, rivet & use structural materials to avoid creation of corrosion problem areas.  
243 \*Amercoat Corp.

**Coatings, Protective** . . . Roofkoter can be applied cold by unskilled labor . . . stays flexible . . . expands and contracts with temperature changes. Won't blister, crack or powder. "Saving Old Roofs."  
454A Tropical Paint Co.

**Coatings, Protective** . . . Detailed phosphating folder, "A Better Bond . . . For Organic Finishes," covers entire line of phosphating and metal protective coating materials. Folder is available upon request.  
454B Turco Products.

**Coatings, Resistant** . . . 4 p. photo-illustrated bulletin describes latest development in sprayable plastisols, Unichrome "Super 5300" Plastisol Coating. Describes single spray application. Request Bulletin SP-1.  
454C Metal & Thermit Corp.

**Electrodes** . . . Illustrated bulletin describes characteristics, properties & sizes of the 5 grades of Ampco-Trode electrodes, both AC & DC. Typical applications are listed for each grade of electrode. Bulletin W-25a.  
454D Ampco Metal.

**Fabrication, Chemical Equipment** . . . Company makes individualized equipment built to your exact specifications. Provides the surest, most dependable means to fast, economical production. Request Bulletin No. 550.  
259 \*L. O. Koven & Bros.

**Fabrication Metal** . . . Booklet, "Facilities & Products," with information & photographs which show why company can turn out—at low cost—specialized heavy equipment for chemical plants, available on request.  
162 \*Newport News Shipbuilding.

**Insulation, Pipe** . . . Catalog features fast, easy way to select economic thickness of pipe insulation accurately . . . efficiently. Introduces simplified method based on a special "J" factor. Unibestos Catalog.  
157 \*Union Asbestos & Rubber Co.

**Insulations** . . . Company offers a set of six insulation case study reports illustrating how actual insulation problems in the petrochemical and petroleum industries were solved. Report available upon request.  
454E Pittsburgh Corning Corp.

**Latices** . . . Company offers newsletter describing the effect of pH on the properties of textile resin finishes modified with Hycar Latex. Also describes washable Hycar top grain leather finish. Issue No. 13.  
454F B. F. Goodrich Chem. Co.

\* From advertisement, this issue

### Keeping too busy?

You'll find our streamlined Reader Service section right up your alley. It's designed for busy engineers who want to find things fast, get more information fast. RS is easy to use, and you can bank on it.



# BASIC FACTS

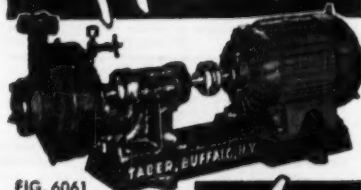


FIG. 6061



Fig. 19,488

for  
DECIDING  
ON TYPE  
OF PUMP;  
Write for  
**TABER**

BULLETIN  
S-146

**Practical  
GUIDE TO  
PUMP  
SELECTION**

Big illustrations and brief descriptions with capacities and adaptability of pumps are contained in this unbiased compilation of facts to help avoid costly misapplication. Bulletin S-146.

**TABER PUMP CO.**  
Est. 1859  
294 Elm St.,  
Buffalo 3,  
N. Y.

# TABER

## LITERATURE . . .

**Linera, Film Pond.** . . . . Bulletin describes a new water tight lining for irrigation and stock-watering ponds, made of Krene plastic to prevent loss of water through seepage. For more information, request Bulletin #9007. 455A *Bakelite Co.*

**Metals, Talide.** . . . . A tungsten carbide of superior quantity, is harder, stronger, and more resistant to abrasion than any other metal. Superior where wear, heat and strain are destructive. Catalog 56-G. 308 *\*Metal Carbide Corp.*

**Paints, Aluminum.** . . . . Asphalt-Aluminum roof paints and coatings provide low-cost, long-life protection for built-up and rustable metal roofs. Reflect sun's heat to keep buildings up to 15° cooler in summer. Details. 385a *\*Reynolds Metals Co.*

**Plastics.** . . . . Many years of research and wide practical experience are behind American Agile in the fields of plastics and corrosion prevention. For detailed information, request your copy of Brochure AA-4. L469 *\*American Agile Corp.*

**Plastics.** . . . . "Plastics in the Home Building Industry" tells the story of newest group of building materials that assure the builder of installation economies, life-time performance, etc. Booklet #9101. 455B *Bakelite Co.*

**Plastics, Electrical.** . . . . Illustrated 8 pg. booklet presents a brief summary of applications, listings of Underwriters' specifications & table of properties for some typical "Geon" electrical compounds. B. F. Goodrich Chem. Co. 455C

**Refractories.** . . . . Carborundum has pioneered scores of super refractories with a wide variety of properties to meet your most demanding requirements. For complete details, request new "Refractories" magazine. 339 *\*Carborundum Co.*

**Refractories.** . . . . The program by which Harblson-Walker controls the properties and quality of the various refractories is described in detail in new brochure, "Better Refractories through Quality Control." 140-1 *\*Harblson-Walker Refractories.*

**Rubber & Plastic Material.** . . . . Piping, pumps, valves and tanks have a wide range of temperatures, pressure, impact resistance. For details about Ace rubber and plastic materials, request Technical Data CE-50. 401c *\*American Hard Rubber Co.*

**Rubbers.** . . . . Booklet contains several charts which analyze the properties of cold non-oil polymers, cold oil-extended polymers, and hot polymers, as well as test recipes and test data. Request your copy. 455D *Goodrich-Gulf Chem.*

**Steel, Lead.** . . . . New 8 p. bulletin describes ALCO leaded steel for seamless forged and rolled rings. Illustrated booklet contains test data, microstructures & a chart of physical properties of Hi-Qua-Lead. 455E *Alco Products.*

**Steels, Stainless.** . . . . Armco 17-4 PH stainless steel offers combination of high strength and hardness, excellent corrosion resistance and simple, low temperature heat treatment in fabrication. Request data. 285 *\*Armco Steel Corp.*

**Stocks, Silicone Rubber.** . . . . New 8 p. brochure describes & illustrates properties & applications for Silastic 50 & 80, two exceptionally useful general-purpose silicone rubber stocks. Contains data, graphs, tables. 455F *Dow Corning Corp.*

**Tantalum.** . . . . Tantalum is immune to hydrochloric acid, nitric acid, bromine, iodine, chlorine and many others. It is strong, immune to thermal shock, unequalled in heat transfer efficiency. See Tantalum Booklet. 404 *\*Fansteel Metallurgical Corp.*

\* From advertisement, this issue



# FLEXIBLE TUBING

Made from

# TEFLON\*

For

Chemical Feed Lines (laboratory, catalyst, pilot plant reusable), Hot Corrosive Liquids or Steam Lines, Hydraulic Hose, Braiding and Fittings for Pressure Use

And Similar Applications Where Only PF TEFLON\* Can Do The Job

## PROPERTIES

- complete chemical inertness
- lowest coefficient of friction of any solid material
- very low permeability
- widest service temperature of any plastic (-450°F to +500°F)
- easily cleaned and sterilized without deterioration

P. F. flexible tubing is available in a full range of colors and sizes. Our extrusion techniques yield maximum service flexibility and all sizes are carefully inspected and controlled dimensionally.

Write, wire or 'phone for additional details, competent engineering assistance and prompt attention to special sizes and walls. Pressure testing and certification upon request.

**PENNSYLVANIA  
FLUOROCARBON CO., INC.**

1115 N. 38th St., Phila. 4, Pa., EV 6-7680

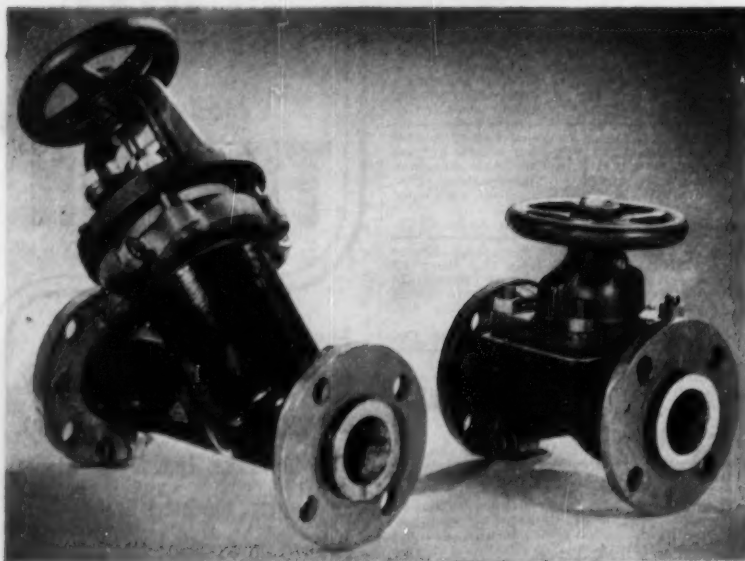
\* "Teflon"—DuPont trade name for Tetrafluoroethylene resin





# News

Wherever CORROSION RESISTANCE is a Factor



## THIS Y-VALVE\* SHUTS OUT CORROSION

...because every surface in contact with solution is made of corrosion resistant Haveg plastic! Exceptional moldability and machinability of Haveg permits these additional advantages for longer, corrosion-free valve service:

- Full valve opening for **fuller, straighter flow**!
- Guided stem for **positive seat alignment**!
- Smooth, sliding stem action permits **lower packing pressure—longer packing life**!
- Double threaded stem for **faster valve control**!
- Removable seat and stuffing box for **easy maintenance**!
- Valve seats in full open position and can be re-packed in this position **while in operation**!

Haveg Y-Valves are available in standard pipe sizes, complete with asbestos-graphite unless otherwise specified and can be equipped for easy connection to air, diaphragm or motor-operated control equipment. Discuss your requirements with a Haveg corrosion engineer.

\*So does this diaphragm valve—ask for data on it, too.

HAVEG PLASTICS OF TOMORROW SOLVE YOUR CORROSION PROBLEMS TODAY

**HAVEG INDUSTRIES, INC.** 920 Greenbank Road, Wilmington 8, Delaware  
Factory: Marshallton, Del. phone WYman 8-2271

Atlanta Exchange 38271	Chicago (Wheaton) Wheaton 9-3225	Cleveland Washington 1-8780	Detroit (Livonia) Riverview 1-1785	Houston Jackson 2-5848	Los Angeles Mifflin 1185	New York (Westfield, N.J.) Westfield 2-7383	Seattle Main 9886	Denver Belmont 7-0433
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### LITERATURE . . .

**Teflon Products**.....Illustrates various of the many special molded & matured, tap changers, core-type core-pure teflon, glass-filled teflon, glass & carbon-filled teflon & silicon-filled teflon. Bulletin No. CP554.  
R461c \*Chemical & Power Products.

**Tubes & Rods, Plastic**.....New 24 p. 2-color catalog on plastic rod & tube stock covers available sizes & prices of stock made of methyl methacrylate, Teflon, cast acrylic, vinyl, polystyrene, cellulose acetate & polystyrene.  
456A Friedrich & Dimmock.

### Electrical & Mechanical

**Clutches & Transmissions, Automatic**.....4 p. bulletin illustrates and briefly describes line of automatic clutches and transmissions presently offered by Salisbury. Bulletin 56-D-1 is made available upon request.  
456B Salisbury Corp.

**Drives**.....8 p. illustrated two-color catalog describes the new 1 through 25 hp Type VS Class 2 Gyrol Fluid Drives. Discusses advantages & typical applications of new adjustable speed fluid drives. Bulletin 9819.  
456C American Blower Corp.

**Drives, Motor**.....New 8 p. bulletin describes motor drives with positive pulley adjustment, ranging from 1/4 to 35 hp. Includes information on selection, engineering features, etc. Request Bulletin No. 1610-BIP.  
456D Worthington Corp.

**Drives, Silent Chain**.....Book gives details and advantages, complete selection and technical data on Link-Belt silent chain drives. Humidity, heat, cold do not lower chain's better than 98% efficiency.  
163 \*Link-Belt Co.

**Gaskets, Teflon-Jacketed**.....Fully illustrated reference covers Chempro's lines of teflon jacketed gaskets, solid ring gaskets, teflon expansion joints and special teflon gaskets. Request Bulletin No. CP553.  
R461b \*Chemical & Power Products.

**Magnets, Permanent**.....Introduction to catalog gives analysis of permanent magnetic properties and importance of engineered applications. Remainder of book features drawings and charts. See Catalog 156.  
456E Magni-Power Co.

**Motors**.....L. A. enclosed and explosion-proof motors feature: split conduit box, inner bearing cartridges, non-sparking fan, cast-iron end bracket and housing, prewound stator, locked bearings. See Bulletin 1700.  
330 \*Louis Allis Co.

**Motors**.....Describes design features of open drip-proof motors in NEMA rated ratings of 1/2 to 40 hp (Type G) and in non-rated ratings of 1/2 to 100 hp (Types AP and APWW). Request Bulletin 51B6210G.  
456F Allis-Chalmers Mfg. Co.

**Motors**.....Part winding starting is available on all popular size Century motors up to 400 hp, polyphase, in drip proof, totally enclosed and explosion proof frames. "Where Low Starting Current is Required."  
283 \*Century Electric Co.

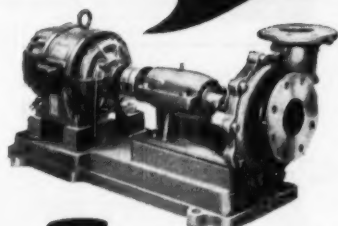
**Motors**.....Bulletin discusses new consolidated line of industrial quality electric motors... new and improved materials, designs and operating features. Company makes details available in Bulletin 1-1P1.  
456G Century Electric Co.

**Motors**.....New Elliott C-W type N motors are designed for the utmost in dependability. They will withstand physical abuse. For complete information on performance and features, request new Motor Bulletin.  
315 \*Elliott Co.

\*From advertisement, this issue



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DEPENDABLE  
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Write for Bulletin No. 107



**FREDERICK IRON AND STEEL, INC.**  
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### LITERATURE . . .

**Motors, . . .** "Synchronizer" contains articles on large motors & controls, enclosure protection for large A-C motors, silicone protection, etc. Request Chemical Industry Number 200-SYN-41.  
457A Electric Machy. Mfg. Co.

**Motors, Direct-Current, . . .** Bulletin describes direct-current motors,  $\frac{1}{2}$  through 200 hp, and motor-generator sets up through 200-kw output. Copies of Bulletin 53B8424 are available upon request.  
457B Allis-Chalmers Mfg. Co.

**Motors, Synduction, . . .** For applications requiring: constant speed, regardless of load or voltage, depending only on frequency; synchronized speed for a number of motors; adjustable speed with minimum variation.  
50 \*Allis-Chalmers Mfg. Co.

**Packings, Ring, . . .** Furnishes complete descriptions of the Chempro lines of teflon ring packings, teflon impregnated asbestos packings, V-type packings and the patented teflon seal cage. Bulletin No. CP552.  
R461a \*Chemical & Power Products.

**Packings, Saddle, . . .** Packs without "nesting," surface area is exposed area, more uniform free space, better liquid distribution, better drainage, less weight. Full technical data in Bulletin No. S-29.  
102 \*U. S. Stoneware.

**Power Supplies, . . .** A very useful Engineering Data Wall Chart is offered, giving tables on decimal equivalents, temperature conversion, wire size & current ratings, mechanical & electrical conversion tables.  
457C Perkin Engineering Corp.

**Reducers, Speed, . . .** Company offers complete specifications and ratings on new economical "In-Line" speed reducers, developed to meet the need for heavy-duty, low-cost gear drives. Request complete details.  
457D Philadelphia Gear Works.

**Seals, Mechanical, Rotary, . . .** Company announces the availability of an 8 p. reference which shows how you get maintenance-free sealing that slashes fluid mixing cost to a new low. See illustrated Bulletin B-111.  
B17g \*Mixing Equipment Co.

**Seals, Selector, . . .** The new Sealol Flexibox Sealector enables you to decide on seal type size and materials for your specific requirements. Covers 48 typical products handled in the process industries. Request Sealector.  
R457 \*Sealol Corp.

**Starters, Compression, . . .** Allen-Bradley compression resistance starters afford a neat solution for smoothing out starting current and torque of heavily loaded squirrel cage motors. See Bulletins 640 and 740.  
64 \*Allen-Bradley Co.

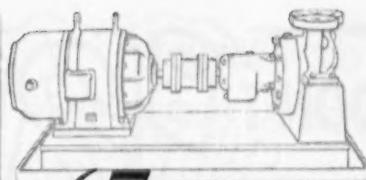
**Starters, Motor, . . .** Built in wide range of ratings for squirrel-cage, wound-rotor & Synchronous motors . . . for full or reduced voltage . . . reversing or non-reversing. Details in Bulletin No. 14B6410B.  
B1 \*Allis-Chalmers Mfg. Co.

**Turbines, . . .** Simplicity and adaptability of Elliott YR Turbine give it advantages that put it well ahead for pump, fan, compressor and other machine applications. Company makes details available in Bulletin H-22A.  
134 \*Elliott Co.

\* From advertisement, this issue

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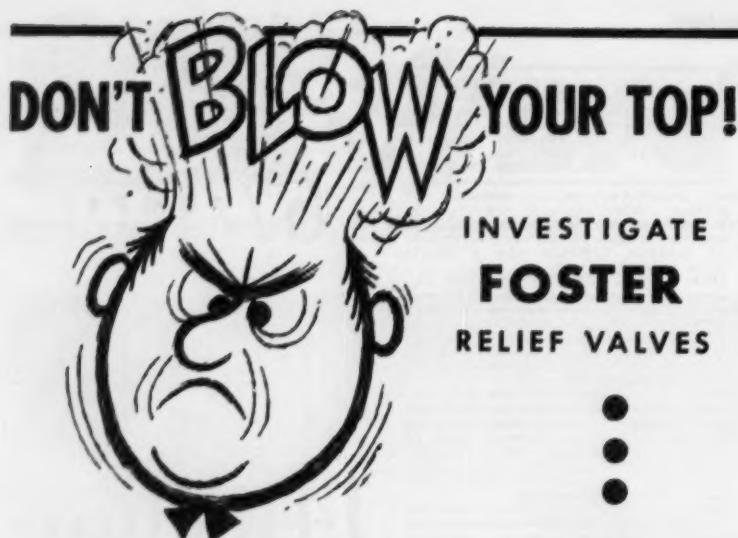
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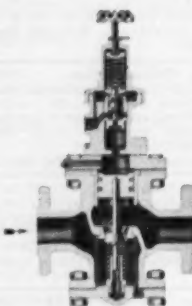


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- SAFETY VALVES
- CONTROL VALVES
- FLOW TUBES



### LITERATURE . . .

**Turbines, Gas.** . . . . The new Clark Mark TA 1130 bhp gas turbine is the most modern, compact and efficient power plant combination you can install. For complete information on Clark turbines, request Bulletin No. 142.  
48-9 \*Clark Bros. Co.

**Turbines, Steam.** . . . . Turbines range from 150 horsepower down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Details in Bulletin 125.  
73 \*Coppus Engrg. Corp.

### Handling & Packaging

**Bag Closers.** . . . . Company offers information on their portable bag closers, designed for handling textile and paper bags. Requires no installation, supports or plant space. Closes average 100 lb. bag in less than 6 sec.  
458A Dave Fischbein Co.

**Belts, V.** . . . . Velos adjustable v-belts assures faster, cleaner work, less vibration, cooler running, greater flexibility & simple installation. Velos Data Book contains valuable engineering data.  
152 \*Manheim Mfg. & Belting Co.

**Containers, Chemical.** . . . . Hackney chemical containers stack four-high . . . save shipping, handling and storage costs. Stainless steel protects dangerous or corrosive chemical products. Hackney Drum & Barrel Catalog.  
15 \*Pressed Steel Tank Co.

**Conveyors.** . . . . Bulletin details the Farquhar line of "Roll-Free" Wheel and Roller Type Gravity Conveyors. Covers construction features, specifications, accessories & installation photographs. Bulletin 801.  
458H Oliver Corp.

**Conveyors, Belt.** . . . . New bulletin describes the Aluminum Stevedore Jr., a portable inclined belt conveyor. Illustrates & describes the units application to loading, unloading, movement of materials, etc. Form 350-56.  
458C Rapids-Standard Co.

**Conveyors, Lift.** . . . . New bulletin describes how the Rapistan Vertical Lift Conveyor can replace costly elevators, save space & the time & cost of an elevator operator. Request copy of Form 1400-56.  
458I Rapids-Standard Co.

**Conveyors, Multi-Tier.** . . . . If you heat, cool, dry, freeze, bake, store, pasteurize or cure, you will be interested in Continuous Multi-Tier Processing for industry. For full details, request Bulletin 55-12.  
75 \*J. W. Greer Co.

\* From advertisement, this issue

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COMMISSIONER OF COMMERCE

#### LITERATURE . . .

**Conveyors, Screw . . .** Link-Belt's sound engineering and quality manufacture assure you of top performance. A 92-page Screw Conveyor Book contains complete ordering data. Request your copy. Book No. 2289. 14 \*Link-Belt Co.

**Conveyors, Vertical . . .** New 4 p. Illustrated bulletin describes Alvey Automatic Vertical Conveyor for loaded pallets. Describes application of the fully automatic Vertical Reciprocator Conveyor. Bulletin ALV-130. 459A Alvey Conveyor Mfg. Co.

**Feeders . . .** Two basic types of Loss-in-Weight Feeders—Duplex Model 31 and Simplex Model 33A—are capable of feeding solids at rates up to 40,000 lbs./hr. with an accuracy of  $\pm \frac{1}{2}\%$  of set feed rate. Request data. 459B Omega Machine Co.

**Fillers, Piston . . .** New Librascope piston fillers will help you cut filling costs . . . vertical action plunger-type valves that maintain positive control of leakage, assure longer valve life. Specifications. 443a \*W. F. & John Barnes Co.

**Filling Machines . . .** Available in 1 to 4-tube models, the Fluopacker Filling Machine packs powdery and granular materials at high speeds, with accurate weights, into smaller, cleaner bags. Fluopacker Booklet. 52-3 \*St. Regis Paper Co.

**Handling, Flammable Liquid . . .** New practical, non-technical, illustrated explanation of the nature and safe plant use of flammable liquids is now available. Covers all phases of handling & application. 459C Protectoseal Co.

**Lifts . . .** New mobile access lifts assure safe working conditions up to 40 feet above floor level. Designed for countless operations in production, installation and maintenance. Request complete information. 459D Ballymore Co.

**Loaders . . .** New Wheaton Loader for organic chemicals and petrochemicals features spring balancing for easy operation and simple, fast packing seal replacement. Full details are available upon request. 459E Wheaton Brass Wks.

**Materials Handling . . .** Engineering & Application booklet covers the principal components of overhead materials systems. Describes in detail: track design & advantages of support-it flexibility. Booklet No. 2068-M. 459F Cleveland Crane & Engineering.

**Packers, Bag . . .** Company offers a brochure describing its new Airflow Valve Bag Packers. Also included is a description of the Black Diamond Screw Type Packer & Settler. Request your copy. 459G Black Products Corp.

**Pulleys, Motor . . .** New bulletin describes variable speed motor pulleys ( $\frac{1}{4}$  through  $\frac{3}{4}$  hp) available with adjustable & tilting bases, companion sheaves, motor bases & V-belts. Bulletin 1630-B1P. 459H Worthington Corp.

**Scales, Bagging . . .** Illustrated bulletin describes design, operation and key features of a new automatic bagging scale, "Weighblender," designed for the "do-it-yourself" pre-mix concrete industry. Bulletin No. 6041. 459I Richardson Scale Co.

**Shovels, Tractor . . .** Bulletin "Modern 'Payload' Tractor Shovels In Industry" describes & illustrates a wide variety of industrial materials-handling applications for "Payload" tractor-shovels. Bulletin No. 304. 459J Frank G. Hough Co.

**Tanks, Storage . . .** A completely new catalog & data book on the patented "Tube-seal" System for floating-roof storage includes description of design & construction, applications, operation, etc. Catalog TS-56. 459K Hammond Iron Works.

\* From advertisement, this issue

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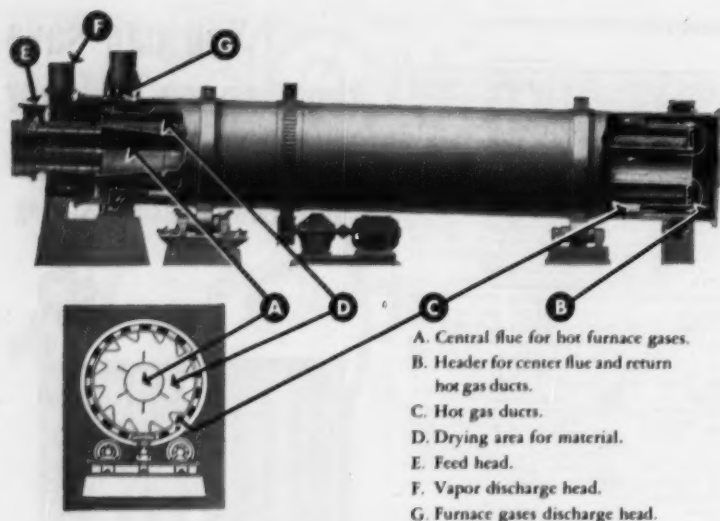
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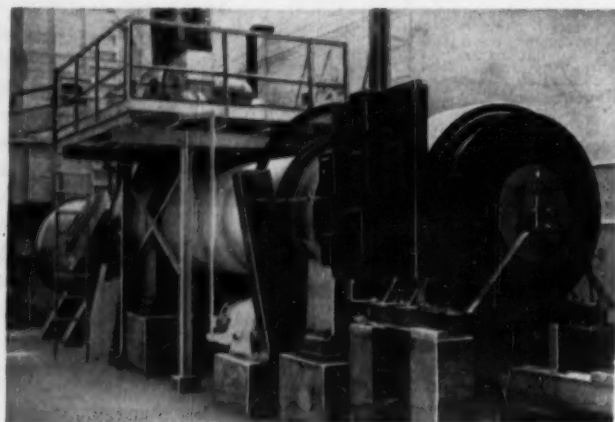


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### LITERATURE . . .

**Trailers, Industrial.** . . . . 2 p. two-color bulletin describes & gives full specifications for Models A-614 & A-443, heavy & extra-heavy duty trailers, of 10 ton & 30 ton capacity respectively. Bulletin TR-103.  
460A Mercury Mfg. Co.

**Trailers, Industrial.** . . . . Offer new 2 p. two-color bulletin describing & giving full specifications for Models A-510 & A-520, fifth wheel steer trailers of four & six ton capacity. Bulletin TR-102.  
460B Mercury Mfg. Co.

**Transport Systems, Pneumatic.** . . . . Illustrated 16 p. brochure details line of pneumatic transport systems. Includes: technical and operating data; installation; application information; etc. Catalog No. 52F.  
24-5 \*Kennedy-Van Saun.

**Trucks, Dump.** . . . . New 2 p. bulletin describes & gives full specifications for Model A-370, a caster-steer truck, & Model A-670, a fifth wheel steer truck. Both dump trucks are available in three capacities. Bulletin TR-104.  
460C Mercury Mfg. Co.

**Trucks, Fork.** . . . . Company offers literature describing Safety Diesel Fork Trucks, which are being used at a growing number of plants where explosive conditions exist. Gives fire-proof safety & handling efficiency.  
460D Allis-Chalmers Mfg. Co.

**Trucks, Fork Lift.** . . . . A colorful Towmo-Torque folder is available giving full data on Towmo-Torque Drive, including detailed information regarding its construction & hydraulic & control systems.  
460E Towmotor Corp.

**Trucks, Fork Lift.** . . . . New 21 p. illustrated bulletin describes power and performance of all-new "Pace-Maker" series of Towmotor fork lift trucks. Describes many models, their operation, etc. Bulletin No. 8F-23.  
460F Towmotor Corp.

**Vessels, Jacketed.** . . . . Choice of standard designs from which you can select jacketed reactors or kettles from 5 to 2000 gallons. Bulletin spells out sizes and detailed specifications. Request Bulletin 904.  
466 \*Pfaudler Co.

## Heating & Cooling

**Burners.** . . . . Bulletin describes "Fireeye System FP-2, Model 1012," a control that programs & safeguards entire operating sequence of fully-automatic rotary register oil & gas burners. Bulletin CP-32.  
460G Electronics Corp. of America.

**Burning Equipment, Sulfur.** . . . . Company offers bulletin on sulfur burning equipment for sulfuric acid plants and for producing sulfur dioxide from sulfur for paper mills and other industries. Bulletin S-110.  
460H Chemical Construction Corp.

**Coils, Steam.** . . . . Company offers bulletin describing their Type S Standard Steam Coils, including application recommendations, specifications, coil dimensions & nomenclature, tables of conversion factors, etc.  
460I McQuay, Inc.

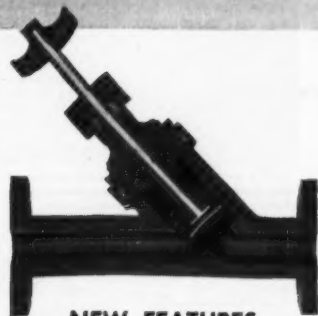
**Coils, Steam.** . . . . Company offers bulletin describing Type J Jet-Tube steam coils, giving applications, features, specifications, coil dimensions & nomenclature, conversion factors, etc. Catalog No. 304.  
460J McQuay, Inc.

**Combustion Installations, Submerged.** . . . . Thermal submerged combustion installations offer simplicity of design and construction . . . plus extreme compactness. Company makes details available in Bulletin 110.  
444 \*Thermal Research & Engrg.

\* From advertisement, this issue



## IMPROVED and EXPANDED Line of Hard Rubber Valves for CHEMICAL APPLICATIONS



### NEW FEATURES

Improved packing of DuPont Teflon is now used in all Luzerne valves.

New line of flanged valves has been added to existing Luzerne line of threaded screw straight way, screw stem angle and globe valves.

This gives you a complete selection of hard rubber valves. Luzerne valves are available in standard hard rubber compounds or in heat resistant Buna-N synthetic compounds for temperatures to 225° F.

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Luzerne offers a complete line of standard and heat resistant hard rubber pipe and fittings carried in stock in all sizes from 1/2" to 4". Sizes over 4" on special order.

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Los Angeles, Calif.

### LITERATURE . . .

**Condensers, Tube.** . . . Condenser Tube Catalog contains practical detailed information on tube condensers and heat exchangers . . . specifications, operation data and maintenance details. Request your copy.  
336a \*Bridgeport Brass Co.

**Coolers, Cascade.** . . . Impervite Cascade Coolers feature low-pressure-drop ells and flush nozzles. Furnished in 5 tube sizes, and 3 different models. Company makes further information available on request.  
423d \*Falls Industries.

**Deaerators.** . . . Tells why this type of deaerator economically provides supply of hot water free from objectionable odor or taste that might be due to steam and fully deaerated to prevent corrosion. Publication 4654.  
461A Cochrane Corp.

**Economizers, Water.** . . . Bulletin describes many models of both the UT-1 & LT-1 Water Economizers which range in capacity from 10TR to 225 TR base rating. Covers constructional details & specifications. Bulletin WE-1.  
461B Mayer Refrigerating Engineers.

**Furnaces.** . . . New 4 p. two-color bulletin fully describes the complete line of Lindberg Hydrazing Furnaces for hardening high carbon & high speed tools without scale, decarb or carburization. Bulletin No. 97-HS.  
461C Lindberg Engineering Co.

**Generators, Steam.** . . . Describe the pre-engineered, standardized steam generators offered in 9 sizes, with capacities of from 50,000 to 150,000 lb. per hr. Includes drawings & design features. Bulletin B-55-4.  
91 \*Foster Wheeler Co.

**Heat Exchangers.** . . . New heat exchange system utilizing steam injection for sterilizing liquid and semi-liquid products. Company makes complete specifications on Barnes Roto-Jet heat exchangers available.  
443e \*W. F. & John Barnes Co.

**Heat Exchangers.** . . . New bulletin describes a new, corrosion-resistant Graphite Heat Exchanger. "Poly-b'oc" features design that eliminates cemented joints and produces continuous turbulence. Bulletin 6550.  
461D Carbone Corp.

**Heat Exchangers.** . . . Distributes Delanium Graphite Block Type Heat Exchangers for Powell Duffryn Carbon Products Ltd. of Hayes, England. Applications as condensers, evaporators, heat exchangers. Cat. 456.  
384 \*Delanium Graphite Co.

**Heat Exchangers, Cross-Bore.** . . . Features a rugged, heavy-duty, one-piece bundle. Cross-Bore exchangers are furnished in standard, single and multipass models. Company makes further information available.  
423e \*Falls Industries.

**Heat Exchangers, Cubical.** . . . Provide maximum transfer surface in minimum space. Design accommodates operating pressures in the 150 psi range. Company makes further information available on request.  
423b \*Falls Industries.

\* From advertisement, this issue

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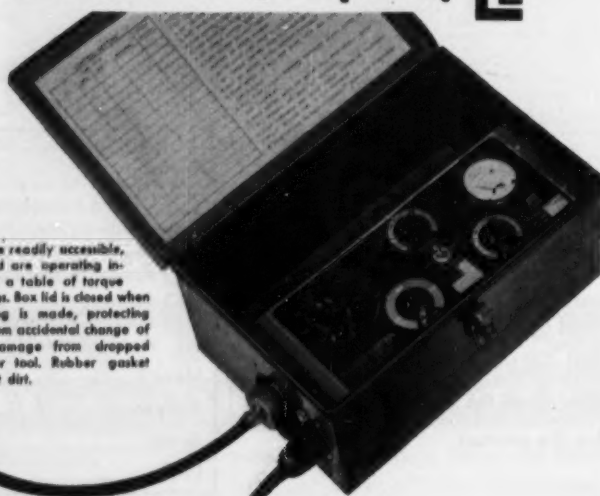
## ELLIOTT electrical control assures tight joints!

The Elliott torque-limiting device enables your operators to get tight, uniform tube joints *every time*! This compact, simple electrical control reduces the chance of tube failure, and tube sheet distortion. By adjusting the Torque Control Knob for the size and kind of tube being rolled, the correct expansion is assured for each tube—regardless of small variations of tube or hole size. A signal lights up, and the motor automatically stops when the tube has been rolled right. Built-in voltage balancer eliminates the need for a voltage regulator.

Elliott Tube Expanders with the Electric Control, described above, form a "package" that takes the guesswork out of tube expanding, and speeds up the operation. For prices and further data, contact the nearest Elliott district office, or write Elliott Company, Lagonda Division, Springfield, Ohio.

**ELLIOTT Company** 

All controls are readily accessible, and in the lid are operating instructions and a table of torque control settings. Box lid is closed when proper setting is made, protecting the control from accidental change of setting or damage from dropped wrench or tool. Rubber gasket keeps out dirt.



Y6-11

### LITERATURE . . .

**Heat Exchangers, Tube & Shell.** . . . All normal tube and shell design features are available as standard. Custom designs are furnished on order. Company makes further information available on request.  
423a \*Falls Industries.

**Heat Transfer Systems.** . . . Capacities can range from small portable units to large gas- or oil-fired units generating from 250,000 to over 10,000,000 B.T.U.'s per hour. Request names of designers & manufacturers.  
171b \*Monsanto Chem. Co.

**Heat Transfer Units.** . . . Valuable ideas based on installations of Tranter Platecoil heat transfer units are contained in bulletin on Platecoil construction, installation and cost-saving advantages. Bul. P-61.  
80 \*Tranter Mfg.

**Heat Treating.** . . . 8 p. "Heat Treat Review" describes solution of a variety of heat treat problems in a southern California commercial heat treat shop, improvement of results with gas chemistry, etc. Volume 7, No. 1.  
462A Surface Combustion Corp.

**Heaters.** . . . Bulletin describes Copen-Vulcan's new Steam-Assist Desuperheater which applies a new, but well-tested principle to reducing high steam temperatures. Includes specifications and capabilities. Bulletin 1024.  
462B Blaw-Knox Co.

**Heaters, Electric Strip.** . . . Bulletin describes Chromalox electric strip heater, including descriptions of pipelines, cylinders & nozzles, kettles, tanks, ovens, air ducts, etc. Request Bulletin F1566.  
462C Edwin L. Wiegand Co.

**Heating Elements.** . . . Brochure gives several case histories of the application of Norton "Hot Rod" Crystolon Heating Elements. Details in "Leading Manufacturers Report Saving with 'Hot Rods'."  
462D Norton Co.

**Heating Units.** . . . "How to Solve Winter Problems With Electric Heat" tells how to prevent condensation, melt snow & ice, heat rooms, provide hot water for the All-Electric Building. Bulletin F1575.  
462E Edwin L. Wiegand Co.

**Heating Units.** . . . "101 Ways to Apply Electric Heat" describes approved methods of electrically heating liquids, air, gases, machine parts and process equipment. Chromalox electric heating units. Catalog F1550.  
462F Edwin L. Wiegand Co.

**Heating Units, Immersion.** . . . Your fuel dollar buys more effective heat transfer with "Surface" immersion heating than with other methods of heating liquids and salts. Details contained in Bulletin CS-156.  
472 \*Surface Combustion Corp.

**Ovens, Dielectric.** . . . Company announces new line of dielectric ovens suitable for heating, baking, drying and curing a wide variety of non-metallic materials. Full details available in Bulletin 56-E.  
462G Young Bros. Co.

**Panels, Heating.** . . . Bulletin describes Web Heating with Chromalox Far-Infrared Radiant Panels. Includes features, advantages, installation features, standard ratings, dimensions & prices. Catalog CS-606B.  
462H Edwin L. Wiegand Co.

\* From advertisement, this issue

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**ANTIFOAM B**

**gives you the ultimate in foam-killing convenience**

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New Dow Corning ANTIFOAM B disperses immediately in aqueous solutions. No stirring or agitation required.

#### ready to use

Just add "as is." No delays for diluting or mixing . . . No need for extra containers.

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Will not oil out, plate out, settle or precipitate in most applications . . . Ideal for continuous processing.

#### stable

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**test ANTIFOAM B at no expense.** Write, wire or phone today for a generous **FREE SAMPLE . . .** and full particulars.



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MIDLAND, MICHIGAN  
first in silicones

#### LITERATURE . . .

**Tandem Combustion Units, Oil-Gas . . . . .**  
You will realize higher profits from your heaters when National Airoll vertical or horizontal tandem units are specified. For full details, request Bulletin No. 498.  
R471 \*National Airoll Burner Co.

**Towers, Cooling . . . . .** High cooling efficiency, low drift losses and rugged, all-redwood construction of new line of FW induced draft cooling towers mean lasting economy and dependability in service. Bulletin CT-56-11.  
333 \*Poster Wheeler Corp.

**Traps, Steam . . . . .** 44 p. book tells how to select traps for nearly every class of equipment; explains safety factors; gives prices, physical data, service pressure ratings of Armstrong traps; etc. See Catalog J.  
22-3 \*Armstrong Machine Works.

**Traps, Steam . . . . .** Give faster, more effective condensate removal. Powerful valves action, positive shut-off, high capacity & each unit service tested. For more details, request new Bulletin No. 10-55.  
68 \*W. H. Nicholson & Co.

**Traps, Steam . . . . .** Yarway Impulse Steam Traps feature: small size—lightweight; only one moving part; stainless steel; won't freeze up. For complete information, request Trap Selector, Bulletin and Diagram.  
99 \*Yarnall-Waring Co.

#### Instruments & Controls

**Bridges, Impedance . . . . .** Company offers information on their Precision Impedance Bridge, Type LB-53 for measurement of resistance, capacity, inductance, dissipation factor and "Q". Catalog L2010.  
463A Radio Corp. of America.

**Cocks, Service . . . . .** Complete line of service cocks, meter & air cocks for moderate-pressure services, is described in new 12 p. bulletin. Main emphasis given to 1692" tamperproof service cock. Bulletin V-605.  
463B Rockwell Mfg. Co.

**Control Equipment . . . . .** New 12 p. booklet describes power plant control equipment. Reviews in detail, combustion and boiler feed water control, pressure reducing, etc. Request Booklet No. 1022-A.  
463C Blaw-Knox Co.

**Controllers, Electronic Contact . . . . .** Features: changing resistor-capacitor can gives single point or differential control; fully adjustable, self-locking differential between high and low contacts. Bulletin 95265.  
340 \*Taylor Instrument Co.

**Controllers, Flow . . . . .** Foxboro M/59 Consotrol Controller is unsurpassed in performance by any other flow controller. It is completely indifferent to weather conditions. For details, see Bulletin 476.  
135 \*Foxboro Co.

**Controllers, Non-Indicating . . . . .** Bulletin describes the Wheelco 150 Series Non-Indicating Controllers, potentiometer type units designed for control applications encountered in batch process work. Bulletin F-7298-1.  
463D Barber-Colman Co.

**Controllers, Pyrometer . . . . .** Multi-Point, Pyrometer Controller provides—in one instrument—automatic temperature control for up to ten separate process units. Company makes further information available in Bul. EDS-25-E.  
451 \*Thermo Electric Co.

**Control Systems, pH . . . . .** Data sheet discusses LeN pH Control System—electrode assembly, Speedomax recorder, Control Unit, Valve Drive. Company makes complete details available in Process Data Sheet 700(2).  
86 \*Leeds & Northrup Co.

\* From advertisement, this issue



**GIFFORD-WOOD'S  
Eppenbach  
HOMO-MIXER**

A high speed, high shear homogenizer-mixer for complete, "no-vortex" mixing of chemicals, cosmetics and pharmaceuticals to produce emulsions of small particle size and long shelf life.

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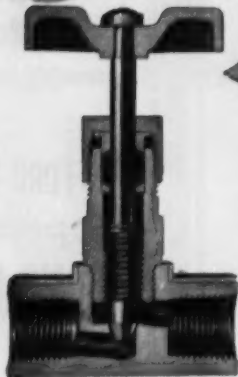
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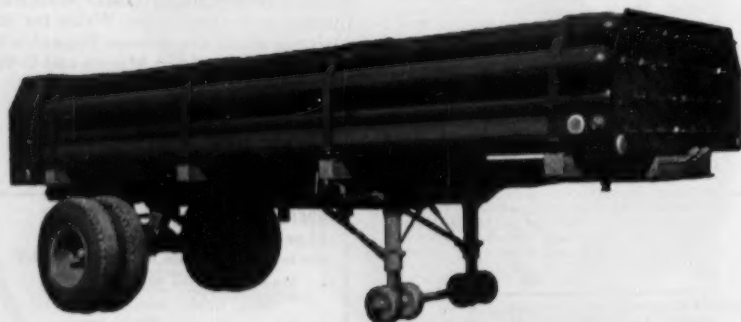


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details, write  
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**TRANSPORTING** — Argon — Carbon Dioxide — Helium — Nitrogen — Oxygen — Boron Trifluoride — Hydrogen — Ethylene. Trailer capacities from 187,000 cu. in. to 750,000 cu. in. water capacity. Trailer tubes ICC3A-2400 Specifications with 2400 PSIG Working Pressure.



Sizes and weights to meet  
all State requirements.  
Can be mounted on bases  
for permanent storage.

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### LITERATURE . . .

**Controls, Furnace & Oven**.....Condensed Catalog & Price List introduces new Electronik Special Class 14 line of Strip Chart, Circular Chart & Circular Scale Instruments. Catalog & Price List B-43-1.  
464A Minneapolis-Honeywell.

**Converters, Differential**.....Details available on how differential converters make possible tighter control in your most critical applications. For further information, request your copy of Bulletin 2290-1.  
316 \*Minneapolis-Honeywell

**Gages**.....With proper application, the new Supergauge will last a lifetime. Supergauges are available in  $\frac{1}{4}$ " and  $\frac{3}{8}$ " sizes. For information on case styles, materials of construction, etc., request Publication 1819.  
446 \*U. S. Gauge Div.

**Gages, Lined**.....Reflex or transparent gages lined with natural and synthetic rubbers, lead, and other materials are ideal where concentration of liquids requires equipment with special linings. Drawing GD-431.  
470 \*Jerguson Gage & Valve Co.

**Meters, Flow**.....Catalog describes company's line of high capacity variable-area flowmeters, specially designed for high capacity services where advantages of linear flow out-put are required. Catalog 10-A-43.  
464B Fischer & Porter Co.

**Gages, Pirani**.....Company offers data sheet describing a new Pirani Gage giving direct, continuous pressure reading from 1 to 2000 microns Hg. Instrument designated as Type 2201-03. Data Sheet No. 9-31.  
464C Consolidated Electrodynamics.

**Generators, Signal**.....Company offers information on their VHF Signal Generator, Type LG-22 intended for use in designing & evaluating receivers, amplifiers, etc. operating at frequencies from 5-230 MC. Catalog L4040.  
464D Radio Corp. of America.

**Generators, Signal**.....Company offers information on their Standard Signal Generator, Type LG-21 designed for application in the engineering laboratory or manufacturing area. Request Catalog L 4010.  
464E Radio Corp. of America.

**Instruments**.....Brochure presents all L&N instruments for chemical process applications. Highlights primary elements for detecting changes in temperature, pH, gas concentrations, etc. Request your copy.  
464F Leeds & Northrup Co.

**Manometers**.....Offer information on Manometers, or Universal U Gages, for water, glycerine, mercury or oil, pressure or vacuum use. Illustrates and describes different types. Bulletin No. 3190M.  
464G Norwalk Valve Co.

**Meters, Flow**.....Absence of obstructions or crevices in the smooth-bore teflon flow tube gives zero pressure drop — facilitates measurement of hard-to-handle sanitary and corrosive liquids. Brochure 1200B.  
351 \*Nuclear Corp. of America.

\* From advertisement, this issue

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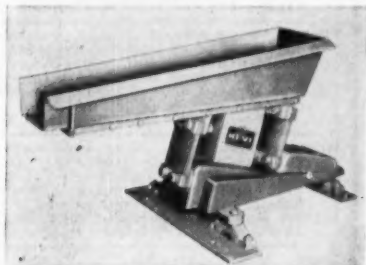
# ERIEZ introduces new ELECTRO-PERMANENT MAGNETIC VIBRATORY FEEDER

No other vibratory feeder like this! Eriez Magnetic "know-how" brings you the first complete line of Electro-PERMANENT Magnetic Feeders operating at 3600 CPM directly off an AC line. Just plug or wire them in.

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AND LOOK AT THESE ADDITIONAL HI-VI ADVANTAGES  
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**VIBRATORY FEEDER**



Rapidly vibrating action moves bulk products in a smooth, even flow. Permits measured feed, from ounces to tons per hour. Eliminates pile-ups, spasmodic feeding. Extremely valuable for weighing, batching and proportioning operations. Eriez HI-VI Vibratory Feeders handle practically every type of bulk material . . . hot, damp, dusty, lumpy, abrasive, etc. Allows highly controlled feeding at greatly reduced costs.

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These products are the latest developments of Eriez Manufacturing Co., world famous producer of permanent-powered Magnetic Separators.

For full information on new HI-VI Vibratory Equipment, write Eriez Manufacturing Company, 74-M Magnet Dr., Erie, Pa.

## LITERATURE . . .

**Meters, Liquid.** . . . Neptune Print-O-Meter prints exact quantities, with serial numbers and code letters to identify the batch and/or station. Print-O-Meter sizes: 1 to 4 in., capacities 5 to 500 gpm. Bulletin 567-H. 449 \*Neptune Meter Co.

**Meters, Velocity.** . . . Alnor Velometer, a precision-built, self-contained, portable instrument, gives instant, accurate readings of air velocities anywhere—in plants, mines, mills or laboratories. Bulletin 2448-G. 1471 \*Illinois Testing Labs.

**Panels, Control.** . . . New 12 p. illustrated bulletin gives at-a-glance application information & lists special Pan-A-Trol control panel benefits in engineering assistance, design, installation, etc. Bulletin GEA-6334. 165A General Electric Co.

**Proportioning Systems.** . . . Richardson Select-O-Weigh Proportioning Systems offer electronic perfection along with precise design of storage bin, feeder, and scale. For complete details, see Bulletin 0351. 81 \*Richardson Scale Co.

**Regulators.** . . . Company offers information on Norwalk District and Station Regulators, including complete descriptions, dimension diagrams and charts. For complete details, request Bulletin No. 7000. 165B Norwalk Valve Co.

**Regulators.** . . . Company offers information on the Pressure Balanced Appliance Regulators for maintaining uniform gas delivery pressure to commercial & industrial gas appliances. Bulletin No. 5500M. 165C Norwalk Valve Co.

**Regulators, Flow Rate.** . . . Type SA flow rate regulators for clear liquids, light slurries and many suspensions, feature: low cost, no lag, no hunting, no outside connections except flow piping. See Form 561. 165D W. A. Kates Co.

**Relays, Ratios.** . . . Hagan "3-15" is ideally suited for any process control systems such as fuel to air ratio in combustion processes, ratio of gases in gas mixing or in proportional feeding of chemicals. Sheet SP4315. 360 \*Hagan Corp.

**Scales.** . . . New Toledo Weight Fact Kit helps you look at your scales as a weighing system—shows you if any scales are "misfits" in capacity, application or location. Helps detect weighing inefficiencies. 421 \*Toledo Scale Co.

**Scanners.** . . . Bulletin describes "Elphorecorder," an automatic paperstrip scanner and integrator. Includes specifications, design, operation, and other information. Request Section D, Sheets 19-20. 165E C. A. Brinkmann & Co.

**Thermocouples.** . . . Complete Conax catalog of thermocouple assemblies & pressure sealing glands introduces new Conax Check Wells, Speedwells, Multiple Wire Thermocouple Glands, etc. Catalog 1556. 165F Conax Corp.

**Thermometers.** . . . "Every Angle" design for installation anywhere; anti-parallax magnification dial that practically eliminates the possibility of parallax error; bi-metal actuation for high sensitivity. See Bulletin 148. 56 \*Manning, Maxwell & Moore.

**Thermometers.** . . . Weston bimetal thermometers are available in types, sizes and ranges for industrial as well as laboratory needs. They are easy to read and right for budget reasons. Details in Bulletin T13. 98 \*Weston Elec. Instrument Corp.

**Thermostats.** . . . Bulletin describes a new heavy duty thermostat which controls two separate circuits simultaneously. Series 22000 dual-control Thermostats. Includes dimensions, availability, etc. Bulletin F-371. 165G Fenwal, Inc.

\* From advertisement, this issue

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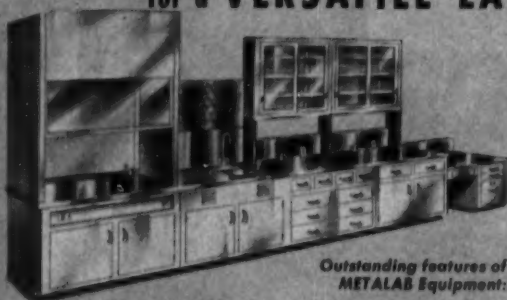
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## LITERATURE . . .

**Voltmeters**.....Company offers information on their DC Null Voltmeter, Type LV-15 used to directly read, test & calibrate various types of equipment. Includes specifications, applications, etc. Catalog L1020.  
466A Radio Corp. of America.

## Pipe, Fittings, Valves

**Clamps, Pipe or Conduit**.....New "Letrobe" Clamp, made of high quality malleable iron, cadmium plated to prevent rust, has double bite of case hardened tool steel. Company makes full details available on request.  
466B Fullman Mfg. Co.

**Cores, Magnetic**.....New 4 p. bulletin describes and gives specifications and data on standard grades of Ferramic "B-2" Magnetic Cores, including graphs, tables, etc. For details, request Bulletin MT-104.  
466C General Ceramics Corp.

**Couplings**.....Packless couplings are ideal in excessive movement where heat weakened soldered or brazed joints won't stand up. They are hand machined of top quality brass. For details, see Bulletin DC.  
418a Packless Metal Hose.

**Couplings**.....New Catalog covers Ajax Series D-100 Standard, Floating Shaft & Mill Motor type Dihedral Couplings. Complete working data on sizes, capacities, & dimensions of Series D-100 Couplings. Catalog No. 62.  
466D Ajax Flexible Coupling Co.

**Couplings, Flexible**.....Up to 15 years maintenance-free service is not unusual with Lovejoy lubrication-free flexible couplings. They are of simple yet rugged construction with double-life cushions. See Catalog.  
4460 Lovejoy Flexible Coupling Co.

**Couplings, Flexible**.....Offers information concerning a new type of coupling incorporating a brake drum flange on the outer diameter. Available in eight standard sizes with hp ratings from 2 to 40 at 1750 rpm.  
466E Lovejoy Flexible Coupling Co.

**Fittings, Forged Steel**.....28 p. catalog on forged steel pipe fittings contains complete dimensional, engineering and application data on forged screw-end and socket-welding fittings for high pressure service. Bulletin A-3-56.  
395 W-S Fittings Div.

**Hose, Hydraulic**.....Company offers a Rubber Covered Hydraulic Hose Selector, containing latest S.A.E. and industry specifications on hydraulic hose. Used to determine proper Wiretex Rubber Covered Control Hose.  
466F Republic Rubber Div.

**Hose, Metal, Flexible**.....Engineered and manufactured to absorb the costly beating your piping system is now taking... efficiently and economically. Available from stock in bronze, Carbon steel & monel. Bulletin IND 4.  
418b Packless Metal Hose.

\* From advertisement, this issue

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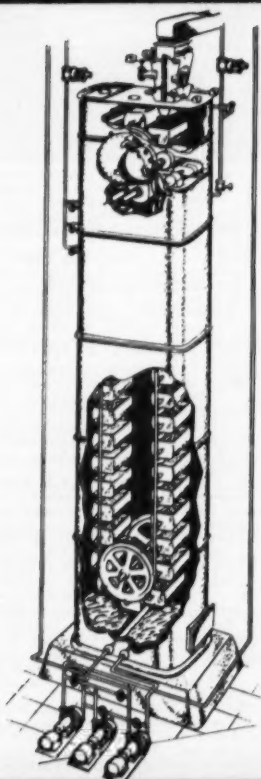


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### LITERATURE . . .

**Hose, Metal, Flexible.** . . . . Penflex is ruggedly built hose with all the flexibility required, plus the toughness and durability of metal. It defies rough abuse, abrasion and crushing. "Flex-Inneering At Work."  
324 •Pa. Flexible Metallic Tubing.

**Joints, Ball, Flexible.** . . . . Advantages: no metal-to-metal contact between moving parts; chemically inert gaskets; pressure safe; fire proof; choice of styles. Further details available in Catalog 215B.  
417 •Barco Mfg. Co.

**Joints & Bellows.** . . . . Sola-Flex bellows & expansion joints are made in all sizes & varieties. They are durable, economical, & are based on advanced engineering designs. Request your copy of the latest Catalog.  
344 •Solar Aircraft Co.

**Joints & Couplings.** . . . . Teflon expansion joints and flexible couplings absorb shock, vibration, thermal expansion and contraction. Connect unlike piping ends and nozzles. Covers complete data in Bulletin EJ-1155.  
397 •U. S. Gasket Co.

**Nozzles, Spray.** . . . . Manarch's advanced design reduces clogging and guarantees dependable applications to . . . wax fruits, rinse vegetables, dry eggs, powder milk, wash filter cake, etc. Request Catalog 1.  
R473 •Monarch Mfg. Works.

**Nozzles, Spray.** . . . . Company makes available on request a completely detailed Catalog which provides valuable data on Spraco Nozzle line. Includes information on full cone, flat spray & hollow cone types.  
T474 •Spray Engrg. Co.

**Nozzles, Spray.** . . . . Company provides a 48 p. industrial catalog with full data on thousands of standard and special nozzles—for every type of spraying. Also information on related equipment. Catalog No. 24.  
T479 •Spraying Systems Co.

**Pipe.** . . . . Bulletin describes flexible tubing which rolls up compactly for carrying & laying out. Made of polyethylene, it resists acids, alkalis, salt water & liquid fertilizers. Request Bulletin #9008.  
467A •Bakelite Co.

**Pipe.** . . . . New 8 p. illustrated bulletin describes company's line of High Impact Rigid Koroseal pipe, fittings & valves. Explains installation, reviews applications & gives physical properties. Bulletin #10050.  
467B •B. F. Goodrich Co.

**Pipe, Hard Rubber.** . . . . Heat-resistant nitrile hard rubber pipe handles inorganics at 250-275 deg. F. . . . also resists wide range of organic chemicals at room temperature. For details, see Bulletin 96-A.  
400a •American Hard Rubber Co.

**Pipe, Plastic.** . . . . General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170°F . . . except few strong acids & organic solvents. Tough, odorless, tasteless. Bulletin No. 80.  
400c •American Hard Rubber Co.

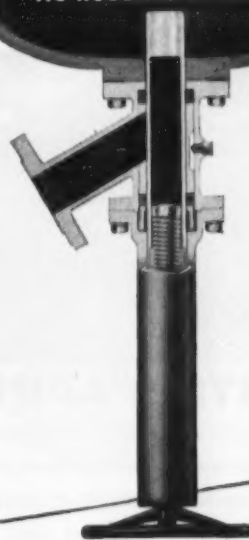
**Pipe, Polyvinyl Chloride.** . . . . Describes Ryertex-Omicron PVC rigid type unplasticized pipe. Gives engineering data on pipe & lists over 200 chemicals it will convey without being attacked. Technical Bulletin No. 86-3.  
172 •Joseph T. Ryerson & Son.

**Pipe, Rigid.** . . . . Odorless, tasteless, rigid polyethylene has the best chemical resistance of any plastic at room temperature except to acetic acid. Rigid pipe 1/2" to 2". For complete details, Bulletin 851.  
401a •American Hard Rubber Co.

**Speedvalves & Fittings.** . . . . Easy, fast tubing assemblies to 10,000 psi are now available with Autoclave Speedvalves and Fittings. Quickly installed in three steps. Bulletin 256 catalogs the entire line.  
60 •Autoclave Engineers.

• From advertisement, this issue

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*Strahman*  
**RAM TYPE**  
Drain Valves

**The Only  
Drain Valve  
That Cannot  
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In the closed position the piston or ram extends up into the tank, preventing plugging of the outlet.

In the open position with piston fully retracted, there is no resistance to flow of materials drained from the tank.

Made in any cast metal to meet your requirements.

Designed for bolting to existing flanges. For special adaptations and for jacketed vessels, adaptor pads are available.

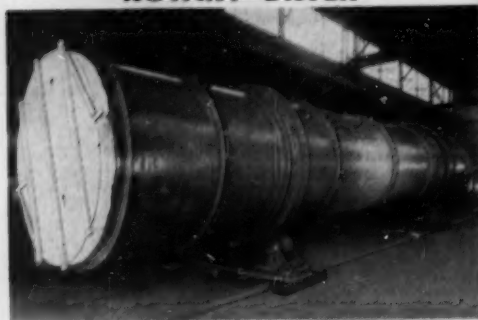
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8' - 0" dia. x 48' - 0" long  
**DAVENPORT HOT AIR  
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**DAVENPORT**  
 PRESSING - DRYING  
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 ANHYDROUS SODIUM METASILICATE

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 more soil-loosening power because  
 DRYMET is so highly concentrated  
 more soil-dispersing power because  
 DRYMET is so highly colloidal  
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 Technical Data.

**CHEMICAL COMPANY**  
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### LITERATURE . . .

**Tubes, Cabled . . . . .** 12 p. technical bulletin describes cabled tubes for instruments & controls, titled "Crescent Armored Multitube System". Describes types of Multitube & methods of installation. Bulletin 356.  
**468A** Crescent Insulated Wire.

**Tubing . . . . .** "Installation Guide for Plastic-coated Raceways" gives installation details for maximum efficiency from plastic-coated rigid steel conduit & electrical metallic tubing. Booklet No. 180166.  
**468B** General Electric Co.

**Tubing . . . . .** "Porous Fiberglass-Epoxy Tubing" describes company's entirely new form of fiberglass-epoxy tubing, known as "Poro-Tube". Completely describes features and gives suggested applications.  
**468C** Lamtex Industries.

**Tubing Supports . . . . .** New 20 p. bulletin explains in detail company's tubing and piping support system. Includes full description on Support Hangers, Sharp Bend Connectors, etc. Request Bulletin No. 656-G.  
**468D** P-W Industries.

**Tubular Products . . . . .** Company offers a new 4 p. folder; ready cross reference between the steel, the application and the specification covering the tubular product; tubing, pipe, fittings and flanges.  
**468E** Babcock & Wilcox Co.

**Unions, Forged Steel . . . . .** After quick & easy installations, even in roughest spots, Orifice Unions will perform superbly in measuring, mixing, blending, strainer or blanking off services. Offers new Catalog.  
**468F** Clayton Mark & Co.

**Valves . . . . .** Alloyco valves with renewable Teflon discs, seats, and packing come with screwed or flanged ends in a variety of styles: globe, Y, angle, swing-check, needle, plug-gate, Request Bulletin No. 11.  
**468G** Alloy Steel Products Co.

**Valves . . . . .** There's an Ace hard rubber, rubber-lined, or plastic-lined valve for every corrosion application. Sizes from 2" to 24". Diaphragm gate and check types. Lists chemicals handled in Bulletin CE-52.  
**468H** American Hard Rubber Co.

**Valves . . . . .** Company offers complete information on the No. 23 Drain or Sampling Valve available in sizes of 1/4", 1/2", and 2 in. N.P.T. Standard materials are carbon steel body and stainless steel stem.  
**468I** Jerguson Gage & Valve Co.

**Valves, Brass Needle . . . . .** Bulletin describes company's new line of low-priced brass needle valves, suitable for air and liquid applications up to 600 psi and can be used as shut-off or throttling valves.  
**468J** Generant Engineering Co.

**Valves, Butterfly . . . . .** In this new Catalog you get the complete dimensions, layout drawings, specifications and materials for all pressure ratings of B-S Butterfly Valves that are now standardized. Catalog 160.  
**468K** S. Morgan Smith Co.

**Valves, Check . . . . .** Company offers an "Examination of Catalog No. 1000 'Series' Check Valves (Gas/Air Services)". Describes examination & tests, equipment, etc. Request Form No. 180.  
**468L** Norwalk Valve Co.

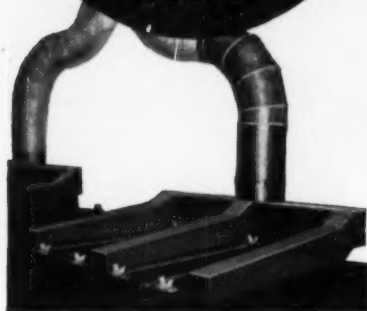
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**PROBLEM:** This company was using a type 19-3 stainless steel stack for venting the fumes on a sulphuric acid tank. This stack was installed at an original cost of \$581, was no longer serviceable after 16 months because of corrosion.

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### LITERATURE . . .

**Valves, Cut-Off . . . . .** Company offers information on the Norwalk Positive Pressure Cut Off Valves, including description of operation, advantages, dimension charts & diagrams. Bulletin No. 7300.  
469A Norwalk Valve Co.

**Valves, Diaphragm . . . . .** From antibiotics to the toughest acids, alkalis and salts, there is a combination of Hills-McCanna body and diaphragm materials that will best suit your needs. Request Valve Catalog 100.  
70 \*Hills-McCanna Co.

**Valves, Drain . . . . .** Offers descriptive information on line of Strahman ram type valves . . . the only drain valves that cannot clog up. Made in any cast metal to meet your requirements. Request complete Catalog.  
R467 \*Strahman Valves.

**Valves, Fittings & Flanges, Drop Forged Steel . . . . .** See 400 p. catalog for complete line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, & refrigeration services. Cat. F-9.  
219 \*Henry Vogt Machine Co.

**Valves, Forged Steel . . . . .** Two new rugged forged steel lines . . . 1300 line includes high flow port area, offering full-flow characteristics . . . 1100 line is compact and economical. Details in Bulletin 195-R.  
321 \*Ohio Injector Co.

**Valves, Gate . . . . .** Complete information is made available about Kennedy's cylindrical design in Standard Bronze Gate Valves, for steam, water, oil, or gas. Available in screwed, solder joint and brazing socket ends.  
469B Kennedy Valve Mfg. Co.

**Valves, Gate, Steel . . . . .** Offer extra Crane ruggedness . . . tight seating with durable seat life . . . positive operation . . . greater freedom from repair and maintenance. For details, see Folder AD-1581.  
287-S \*Crane Co.

**Valves, Needle . . . . .** The Marsh needle valve is now available in 416 stainless steel throughout. It is guaranteed for working pressure up to 10,000 psi. For complete details, request Bulletin No. NV-2.  
T464 \*Marsh Instrument Co.

**Valves, Needle . . . . .** Illustrated 68 p. catalog contains specifications on needle valves of all sizes as well as toggle valves, packless valves, special purpose valves, fittings and accessories. Request your copy.  
406 \*Hoke Inc.

**Valves, Porcelain . . . . .** Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications of product line.  
261 \*Lapp Insulator Co.

**Valves, Reverse Flow . . . . .** Company offers information on the Norwalk Reverse Flow Relief and By-Pass Valves for gas, air and liquids. Includes dimension diagrams, etc. Request Bulletin No. 6600.  
469C Norwalk Valve Co.

**Valves, Thermostatic Control . . . . .** New 8 p. condensed catalog describes the Lawler Line of Thermostatic Control Valves. Highlighted is the BCA Concealed Shower Mixing Valve. Request Catalog #C-7.  
469D Lawler Automatic Controls.

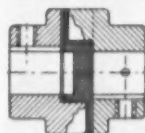
## Process Equipment

**Bellows . . . . .** FLEXON Bellows Design Guide contains valuable information on applications, design considerations, and standards for metallic bellows. Specific details on using bellows are included. Catalog 155.  
469E Flexonics Corp.

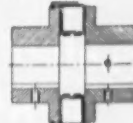
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Standard Duty Types  
0.5 to 40 hp. at 1750 rpm.



Medium and Heavy Duty Types  
2.6 to 810 hp. at 100 rpm.



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1.9 to 30 hp. at 100 rpm.—2 to 40 hp. at 1800 rpm.

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11 to 740 hp. at 900 rpm.

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- No lubrication required.
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- Double-life cushions—one half the cushions act as idlers, except on reversing loads—quick interchange provides a new set of cushions.
- Cushions are engineered to the load and service conditions.

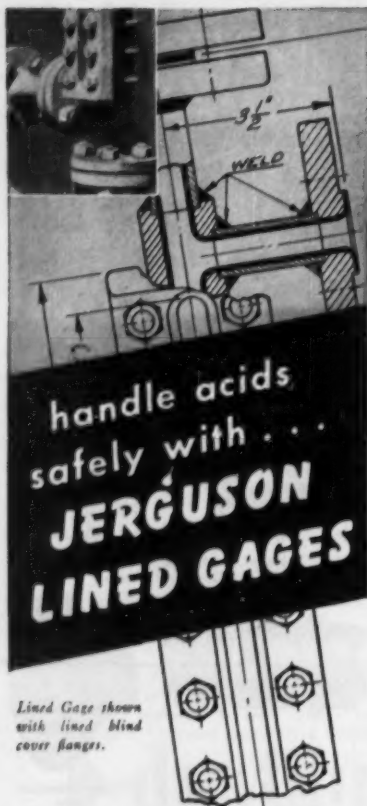
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Lined Gage shown with lined blind cover flanges.

WHERE concentration of liquids such as sulphuric, muriatic or other acids necessitates equipment with special linings, Jerguson can furnish you with reflex or transparent gages lined with natural and synthetic rubbers, lead, phenolic base compounds, Teflon, and other materials. Jerguson Lined Gages are designed to meet your requirements of long-life and dependable operation.

To meet your constantly increasing variety of demands, Jerguson engineers, working closely with the men in the Chemical and Petrochemical Fields, have developed a complete line of sound, dependable liquid level gages, valves, and specialties in various metals and synthetics to handle corrosive liquids and gases.

*Jerguson Gages keep you out of trouble, and they save you time and money. Send for drawing GD-431 on Lined Gages, or send your requirements.*

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 Offices in Major Cities  
 Jerguson Tress Gage & Valve Co., Ltd., London, Eng.  
 Pétrole Service, Paris, France

#### LITERATURE . . .

**Blenders . . . . .** Company offers information on portable low-cost dry mix and liquid blenders, "Porta-Blend". Describes all features, giving assembly diagrams, specifications & dimensions. Bulletin No. NP16-419.  
**470A** \*Strong Scott Mfg. Co.

**Blenders, Twin Shell . . . . .** Standard model Twin Shell for gentle mixing action, "Intensifier" for difficult-to-blend materials, "Liquid-Solids" blender for blending liquids into dry materials. Catalog 14.  
**105** \*Patterson-Kelley Co.

**Centrifugals . . . . .** Batch-Master offers choice of perforate and imperforate baskets . . . corrosion-resistant materials . . . manual unloader if desired. Further information available in Bulletin TC-14-56.  
**409** \*Tolhurst Centrifugals.

**Centrifuges . . . . .** High speed dehydrating centrifuge offers precise external control of variations in flow rate, crystal size & slurry concentration. Permits intermediate treatment of crystals. Bulletin No. 1257.  
**127** \*Sharples Corp.

**Chlorinators . . . . .** New 19 p. catalog describes a high-capacity chlorinator, a vacuum-type solution-feed gas chlorinator for capacities 60 lbs. to 6000 lbs. of chlorine gas per 24 hours. Catalog 70-15.  
**470B** \*Fischer & Porter Co.

**Deaerators . . . . .** Cochrane publication describes a deaerator design that eliminates tubular vent condensers without impairing efficient purging of noncondensable gases. Request publication 4651.  
**470C** \*Cochrane Corp.

**Discs . . . . .** Guide describes all Jenkins Discs, and their applications for steam, hot and cold water, air, gas, oil, gasoline . . . including new Teflon Disc for lasting, dependable control of oxygen, etc. Form No. 203.  
**341** \*Jenkins Bros.

**Disks, Rupture . . . . .** Impervite Rupture Disks are standard for 150# flanges, temperature to 300° F., 5% accuracy, diameters from 2" to 12". A new idea in fragibles from Falls . . . expendable and economical. Literature.  
**423f** \*Falls Industries.

**Dryers . . . . .** Lectro-dryers can dry air & gases in volume to dewpoints below -100°F.—can drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.  
**284** \*Pittsburgh Lectrodryer Corp.

**Dryers . . . . .** Company offers a freeze drying brochure which fully describes and illustrates their diverse line of seven types of dryers in all price ranges along with 50 odd versatile accessories. Bulletin FD.  
**470D** \*E. Machlett & Son.

**Dryers, Conveyor, Vibrating . . . . .** Catalog describes Jeffrey conveying equipment. Jeffrey engineers will help you no matter what your processing-conveying problem . . . drying, heating, cooling, screening. Cat. 860.  
**158** \*Jeffrey Mfg. Co.

**Dryers, Rotary . . . . .** The Davenport rotary hot air dryer is of stainless steel construction. Dryer is installed in one of the large processing plants, drying wheat gluten. For complete details, request Catalog "A."  
**T468** \*Davenport Mach. & Foundry.

**Dust Collectors . . . . .** The efficiency of Type W Roto-Clone dust collector results from its unique design, which combines the scrubbing action of liquid sprays and the principle of dynamic precipitation. Bul. 274.  
**348** \*American Air Filter Co.

**Dust Collectors . . . . .** Maximum filtering efficiency, bag cleaned uniformly and automatically, overcleaning eliminated to prolong bag life, easy to assemble in less space. For further details, request Aeroturn Booklet.  
**93** \*Koppers Co.

**Dust Collectors . . . . .** In almost every type of industry . . . users have found high efficiency, simplicity & economy of Dustube collectors a difficult combination to equal for top performance. Request Bulletin No. 372.  
**512** \*Wheelabrator Corp.

**Eliminators, Mist . . . . .** If liquid entrainment is a contributing factor in design or operation, Metex Hi-Thruput Mist Eliminators will assure greater production, improved quality of yield and reduced costs. Bul. ME-6.  
**455** \*Metal Textile Corp.

**Filter Materials . . . . .** Company offers technical information on Wool Felt-Liquid Filtration. Includes characteristics, properties, performance data, of wool felt, & filtration methods. Sheet No. 17.  
**470E** \*American Felt Co.

**Filter Paper . . . . .** The use of E&D filter paper as a cover may be indicated if your filter medium is blinding or clogging. Will recommend proper grade for use and send samples for testing. "Filtration Analysis Report."  
**T466** \*Eaton-Dikeman Co.

**Filters . . . . .** Alsoop filters, mixers and tanks are available in a complete range of sizes and capacities and Alsoop equipment is custom fitted to your application. Company makes complete catalog available.  
**B459a** \*Alsoop Engineering Corp.

**Filters, Backwash . . . . .** You can clean Adams filters by operating a few valves . . . no time consuming or dangerous manual disassembly and cleaning necessary. If you have a chemical filtration problem, see Bulletin 431.  
**403** \*R. P. Adams Co.

**Filters, Horizontal Plate . . . . .** New "Batch-Miser" horizontal plate filter recovers 100% of both liquid and solids—without scavenging. There is no leakage, no warping of plates. Request descriptive Bulletin.  
**408** \*Niagara Filter Div.

**Filters, Horizontal Pressure . . . . .** Filters with many convenience features: quick opening door, shakers for cleaning, equal size leaves. Can be automated for continuous operation. Request Bulletin NH-122-1155.  
**6-7b** \*Industrial Filter & Pump.

**Filters, Liquid . . . . .** Company offers 12 pg. bulletin describing its Staynew filter. Contains engineering & performance data, photos, descriptions of filtering media, recommended use of each, etc. Request Bulletin 300.  
**78** \*Dollinger Corp.

**Filters, Tubular . . . . .** Excellent for polishing, as a trap filter or scavenger. Operation and cleaning is greatly simplified by inside-out flow system. For complete details, request Bulletin TS-160-755.  
**6-7c** \*Industrial Filter & Pump.

**Filters, Vertical . . . . .** Standard or specially engineered models for any filtration process. Available with various rapid cleaning features and fully automatic controls. Request Bulletins 111 and 114-1155.  
**6-7a** \*Industrial Filter & Pump.

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**ALNOR VELOMETER**

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FOR EVERY INDUSTRY

### LITERATURE . . .

**Fluidizers . . . . .** Company offers bulletin entitled "Transport of Flour by Fluidization", giving uses & advantages of a Fluidizer, including schematic diagrams, design factors, etc. Request your copy.  
471A \*Superior Separator Co.

**Generating Units, Steam . . . . .** Vogt steam generating units are available in types and sizes to meet individual plant needs for power, processing or heating. Available bulletins feature complete details.  
355 \*Henry Vogt Machine Co.

**Generators, Gas . . . . .** Compact unit produces protective atmospheres from natural gas or commercial propanes for processing and packaging. Provides constant, oxygen-free atmosphere. Request specifications.  
443b \*W. F. & John Barnes Co.

**Grinding Machines . . . . .** Sturtevant Micronizer grinding machines give greater fineness than tube or roller mills. Feature: no moving parts; instant accessibility; easy cleaning. For details, see Micronizer Bulletin.  
323 \*Sturtevant Mill Co.

**Homogenizer-Mixers . . . . .** High speed, high shear, homogenizer-mixer for "novortex" mixing of chemicals and pharmaceuticals to produce emulsions of small particle size and long shelf life. Catalog 402R-2.  
R463 \*Gifford-Wood Co.

**Mills, Ball & Pebble . . . . .** Of welded steel construction, and furnished in all standard sizes from 18" x 74" to 96" x 144" inclusive, with 9 different drive arrangements. For details, see Bulletin 100-A and 100-B.  
317f \*International Engineering.

**Mills, Roller . . . . .** Positive and continuous precision size control at exceptionally high production rates are but two of the numerous features of Williams Roller Mills. Request fully descriptive new Catalog.  
357 \*Williams Patent Crusher.

**Mixers . . . . .** If you have a process entailing critical operating conditions, request information on durable Eastern Mixers. Offers engineering assistance in the selection of proper mixers. Request catalog series.  
273a \*Eastern Industries.

**Mixers . . . . .** Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.  
217h \*Mixing Equipment Co.

**Mixers . . . . .** Standardization, high production and complete control of all manufacturing by Philadelphia Gear Works assures you outstanding mixer performance at minimum cost. For details, see Bulletin A-256.  
26-7a \*Philadelphia Gear Works.

**Mixers . . . . .** Company issues a new bulletin providing operating feature information, illustrations & specifications on Double Faddle Mixers. Illustrates both Tilling Heat & Vertical Raising Head Models. Bulletin 209.  
471B Cincinnati Hildebrand Co.

**Mixers, Portable . . . . .** Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. Bulletin B-108.  
217e \*Mixing Equipment Co.

**Mixers, Side Entering . . . . .** Company can furnish either standard packed stuffing box or mechanical seals. On most standard types either seal can readily be converted to the other, as desired. Bulletin 72-B.  
317b \*International Engineering.

**Mixers, Side Entering . . . . .** Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.  
217d \*Mixing Equipment Co.

\* From advertisement, this issue

## VERTICAL

OR  
HORIZONTAL

many more hours on stream  
without forced shutdown

with **NATIONAL AIROIL**

### OIL-GAS TANDEM COMBUSTION UNITS

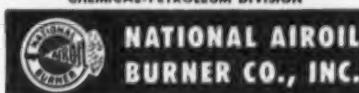
Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . plus; special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvers for positive control of vertical flame pattern; and all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvers, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL or HORIZONTAL Tandem Unit is always fired with National AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT'S clean flame, a cold furnace can be brought to full capacity in a short time.

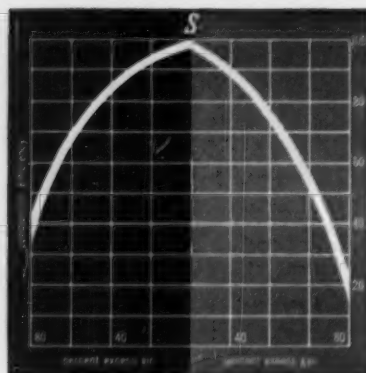
Many, many more hours on stream, without shutdowns" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

### CHEMICAL-PETROLEUM DIVISION



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INDUSTRIAL OIL BURNERS, GAS BURNERS,  
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Even a little excess air hurts combustion efficiency.

Excess gas decreases combustion efficiency even more.

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Another reason you get the most heat per penny spent for fuel with 'Surface' burners: they give you peak combustion efficiency. Conventional burners, with excess air or gas, throw away much of your potentially usable heat. With 'Surface' Automatic Proportioning, the precise amount of air required for complete combustion is constantly mixed with the gas.

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Write for Bulletin SC-156.

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### SURFACE COMBUSTION

Also makers of Janitrol® automatic space heating and Kathobar® humidity conditioning

#### LITERATURE

**Mixers, Top Entering.....** Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. Catalog No. B-162.  
217a \*Mixing Equipment Co.

**Mixers, Top Entering.....** Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog No. B-163.  
217b \*Mixing Equipment Co.

**Prebreakers.....** New bulletin, for the food & chemical process industries, discusses the applications of different models of Prebreakers & Mastigators to the size reduction and/or mix-of bulky solids. Bulletin F-508.  
472A Riets Mfg. Co.

**Process Equipment.....** New Pfaudler Buyer's Guide is available covering the firm's corrosion-resistant process equipment. Gives information on custombuilt equipment, columns, condensers, tanks, etc. Bulletin #2936.  
472B Pfaudler Co.

**Process Equipment.....** Large scale and special purpose process equipment for the chemical, textile, plastic, rubber and allied industries is described in new brochure. Design and construction details given. Bulletin 236.  
160 Dravo Corp.

**Processing Equipment.....** Describes corrosion-resistant processing equipment . . . precision built to your specific requirements to give long years of peak performance with low maintenance. Technical Bulletins.  
385 \*Lee Metal Products Co.

**Propellers, Fabricated.....** "Fabricated" propellers will do a perfect job of mixing, blending, stirring, pumping or aerating in applications requiring relatively low horsepower and not over 1750 LPM. Request catalog.  
B474 \*Michigan Wheel Co.

**Reclaimer Systems, Oil.....** A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. Offers full details on reclaimers in Bulletin R-160.  
411 \*Hilliard Corp.

**Scalpers, Reel.....** Company offers illustrated bulletin describing their Reel Scalper, the first all-metal reel scalper. Gives assembly diagram, list prices, dimensions, and describes features.  
479C Strong Scott Mfg. Co.

**Screens, Gyratory.....** All-metal unit is designed to separate dry granular materials into two, three and four predetermined sizes. Information on Allis-Chalmers gyratory screens in Bulletin No. 07B3446.  
373 \*Allis-Chalmers Mfg. Co.

**Separators.....** Company offers information on their Feeder-Magnetic Separator and Self-Cleaning Spout Magnet. A positive feed control mechanism embodying a revolutionary self-cleaning magnet.  
472D Strong Scott Mfg. Co.

**Stills, Centrifugal.....** Describes a large, low-priced, laboratory centrifugal molecular still which can simulate on a pilot-plant scale the molecular distillation obtained in costly commercial stills. Sheet 3-10.  
472E Consolidated Electrodynamics.

**Utilizers.....** New Standard Utilizer assembles and builds unit-loads in desired shape and size . . . automatically . . . directly from conveyor line. Expedites production while cutting handling costs. See Bulletin 0-12.  
410 \*Standard Conveyor Co.

**Wire.....** "The Cambridge Wire" - a quarterly publication gives up-to-date information on applications of all Cambridge products in specific industries, technical articles, & latest development news.  
473F Cambridge Wire Cloth Co.

**Wire Cloth.....** 80 p. catalog describes company's facilities for fabricating wire cloth parts. Includes wire cloth parts for screening, filtering and special uses. Also provides helpful metallurgical information.  
395 \*Cambridge Wire Cloth Co.

**Wire Cloth.....** Wire cloth made of all malleable metals such as aluminum, brass, bronze, phosphor bronze, copper, monel, Nichrome, nickel and stainless steel. Company makes details available in Catalog E.  
448 \*Newark Wire Cloth Co.

## Pumps, Blowers, Compressors

**Blowers.....** Precision manufactured to move more gas or air with less wear than other blowers of equal size or weight . . . and with less maintenance and power costs. Describes line in detailed Bulletin B-154.  
412 \*Read Standard Corp.

**Blowers.....** 4 p. folder lists and describes Hoffman pumps, exhausters, pneumatic systems, filters, flotation equipment, separators, stills, smooth-flow tubular pipe and fittings. Request your copy.  
472G U. S. Hoffman Machy. Corp.

**Compressors, Centrifugal.....** De Laval compressors are designed and built for heavy duty continuous operation. Rugged, horizontally split casings . . . individually designed impellers . . . etc. See Bulletin 0504.  
326 \*De Laval Steam Turbine Co.

**Compressors, Centrifugal.....** Centrifugal compressor units, ranging from 200 to 2000 tons, are used in comfort and industrial process air conditioning. Company offers complete construction and performance data.  
472H Surface Combustion Corp.

**Compressors, Oil-Free.....** Joy WG-9 oil-free compressors are equipped with carbon graphite piston rings. Need no lubrication, and compensate automatically for wear. For further information, request Bulletin 104-11.  
8 \*Joy Mfg. Co.

**Compressors, Piston, Carbon.....** You get pure, oil-free air that's safe for textiles, plastics, foods, beverages, automation instruments and low-cost air that's economical for maintenance tools. See Bulletin CRC-10.  
170 \*Gardner-Denver Co.

**Exhausters, Industrial.....** Heavy all-welded steel plate for strength, smooth interior surfaces for minimum friction. Interchangeable Air Wheels or Material Wheels. Complete details available in Bulletin 3576.  
352e \*Buffalo Forge Co.

**Fans.....** American Blower Ventura Fans offer you top performance and economical ventilation. Two bulletins cover product information . . . Bulletin 6514 for Model K and Bulletin 6414 for Model G Fans.  
58 \*American Blower Corp.

**Fans.....** Extremely quiet and high in efficiency; stable performance from zero pressure to shutoff; non-overloading regardless of system pressure. Request BL Bulletin F-101 and BLH Bulletin F-200.  
352a \*Buffalo Forge Co.

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352b \*Buffalo Forge Co.

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352e \*Buffalo Forge Co.

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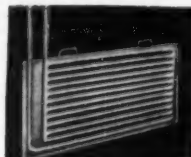




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335 \*Aldrich Pump Co.

**Pumps.** . . . . Practical Guide to Pump Selection—illustrations & descriptions with capacities & adaptability of pumps contained in compilation of facts to help avoid costly misapplication. Bulletin No. S-146.  
L455 \*Taber Pump Co.

**Pumps, Acid.** . . . . 80-gpm. centrifugal pump with hard rubber casing and impeller, Hastelloy C shaft. Handles nearly all corrosives. Mechanically simple, trouble-free. For information, request Bulletin CE-55.  
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400b \*American Hard Rubber Co.

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281 \*A. R. Wilfley & Sons.

**Pumps, Centrifugal.** . . . . Easily adapt to changing conditions & demand, save power, combat corrosion & erosion. Speeds, 1750 & 3500 rpm; capacities to 600 gpm; heads to 200 ft. Request Bulletin P-3C for details.  
390 \*Ampeco Metal.

**Pumps, Centrifugal.** . . . . Standard, single stage, end suction, centrifugal process pumps . . . Series 10, 20 and 30 . . . for industrial, refinery and general service are described in a new, Illustrated Circular No. 184B.  
410 \*Dean Bros. Pumps.

**Pumps, Centrifugal.** . . . . Standard Imper-vite pump models are furnished up to 200 gpm, 100 ft. head, and specials are available in the range of 1000 gpm. Company makes further information available upon request.  
423e \*Falls Industries.

**Pumps, Centrifugal.** . . . . Illustrated reference describes line of 88V centrifugal pumps. Includes details of construction of the various sizes available, operating advantages for users, etc. Bulletin No. 107.  
L457 \*Frederick Iron & Steel.

**Pumps, Chemical.** . . . . Furnishes a complete line of Buffalo pumps, ready to handle corrosive or abrasive liquids at least maintenance cost. For full product information, request Illustrated Bulletin 982.  
392 \*Buffalo Pumps.

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13 \*Goulds Pumps.

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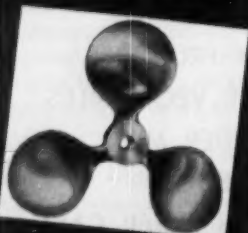
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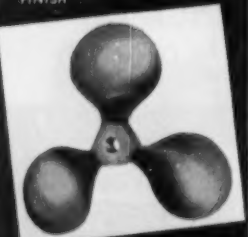
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**Pumps, Filter.** . . . . Filter pumps for highly corrosive solutions are described in 8 p. bulletin. Pumps are self-priming, leakproof, centrifugal type, all plastic, incorporate backwashing features. Bulletin 102.  
474A Sethco Mfg. Co.

**Pumps, Propeller.** . . . . Lawrence Propeller Pumps are made of the metals and alloys best suited for their ability to resist the corrosive and abrasive action of the liquid pumped. Request Bulletin 203-7.  
418 \*Lawrence Pumps.

**Pumps, Proportional.** . . . . Company offers information on Series 500 proportional mixing-metering pump for two part resins. Choose from several models for potting-casting, encapsulating, adhesives, foams.  
474B H. V. Hardman Co.

**Pumps, Rotary.** . . . . "Continuity" catalog defines firm's entire new internal gear rotary pump line. Contains definitive, useful and easily derived pump information. All data provided in actual performance figures.  
474C Wayne Pump Co.

**Pumps, Rotary.** . . . . Company offers descriptive bulletins on Roper pump-motors, Series P pumps, Series K pumps, Series H pumps and Series 3600 pumps. Complete details are contained in these bulletins.  
416 \*Geo. D. Roper Corp.

**Pumps, Rotary.** . . . . Company offers booklet to help locate and correct common ailments of rotary, centrifugal, and steam pumps. Gives full description of pump troubles. For details, see Bulletin PC-508P.  
474D Worthington Corp.

**Pumps, Vacuum.** . . . . Stokes Vacuum Calculator simplifies calculation of pump performance and selection of pump size for specific applications. Full story on Microvac design features in Catalog No. 752.  
156 \*P. J. Stokes Corp.

**Vent Sets, Belted.** . . . . Efficient, quiet, non-overloading. Simple package installation, indoors or out. Capacity adjustable by changing sheaves. Capacities from 1000 to 20,000 cfm. Details in Bulletin 3720.  
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474E E. D. Bullard Co.

**Grating & Stair Treads.** . . . . Blaw-Knox electroforged steel grating makes every step a safe step indoors or outdoors. Makes available new reference & quotations. For more information request Bulletin 2486.  
332 \*Blaw-Knox Co.

**Injection Molding.** . . . . New 51 p. book on Injection Molding of Tenite Acetate and Tenite Butyrate, deals with the methods of forming the Tenite materials into finished articles by injection molding.  
474F Eastman Chem. Prod.

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B477 \*Duralab Equipment Corp.

**Laboratory Equipment & Furniture.** . . . . Line of sectional units designed for interchangeability & flexibility assures a synchronized installation which will produce peak efficiency. 180 p. Catalog 4B & Supplement 55-A.  
B466 \*Metalab Equipment Corp.

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## LITERATURE

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139 \*Stewart-Warner Corp.

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475A John Hassall, Inc.

**Painting & Coating.**.....In a leaflet entitled "Painting", the problem of painting & coating failures & what can be done to salvage certain situations are discussed in brief. Some typical cases are cited.  
475B Foster D. Snell, Inc.

**Plant Sites.**.....Data on raw materials, transportation, power and fuel, markets, labor, facilities, sites, community services, laws and regulations, etc. Also includes physical map. "Industrial Location Services."  
L450 \*N. Y. State Dept. of Com.

**Plants, Chemical.**.....Brochure describes plants for manufacture of alkylid resins, fatty alcohols, phenolic resins and maleic anhydride, and for fatty acid hydrogenation. Offers typical flow sheets, etc.  
475C Industrial Process Engineers.

**Plants, Nitric Acid.**.....Girdler nitric acid plants offer greater economy, in both investment and operating costs, than atmospheric or low-pressure units. Company makes complete details available in bulletin.  
2 \*Girdler Co.

**Processes, Bonding.**....."The Permazing Story," a unique illustrated brochure, describes Permazing, the rubber-to-metal bonding process developed by Stillman Rubber Co. Copies are available upon request.  
475D Stillman Rubber Co.

**Reproduction Materials.**.....Kodagraph reproduction materials for new techniques... new savings... new standards of quality—in drawing and document reproduction. Request new booklet on Kodagraph materials.  
169 \*Eastman Kodak Co.

**Splices.**.....New 4 p. illustrated booklet contains instructions & application information for the new "Scotchcast" brand splicing kit 90-B1. Describes advantages electrical & physical properties, etc.  
475E Minnesota Mining & Mfg. Co.

**Tread Plate, Abrasive.**.....New Alcoa abrasive aluminum tread plate means safe footing. Slip-proof under oil or water films on inclines up to 30°. For details, see "Alcoa Abrasive Tread Plate."  
65 \*Aluminum Co. of America.

**Yarns, Textile.**.....New 8 p. brochure contains facts about the company's textile yarns. Describes product & some end uses. Includes yarn comparison table, etc. Request copy of form TYN-1.  
475F L.O.F. Glass Fibers Co.

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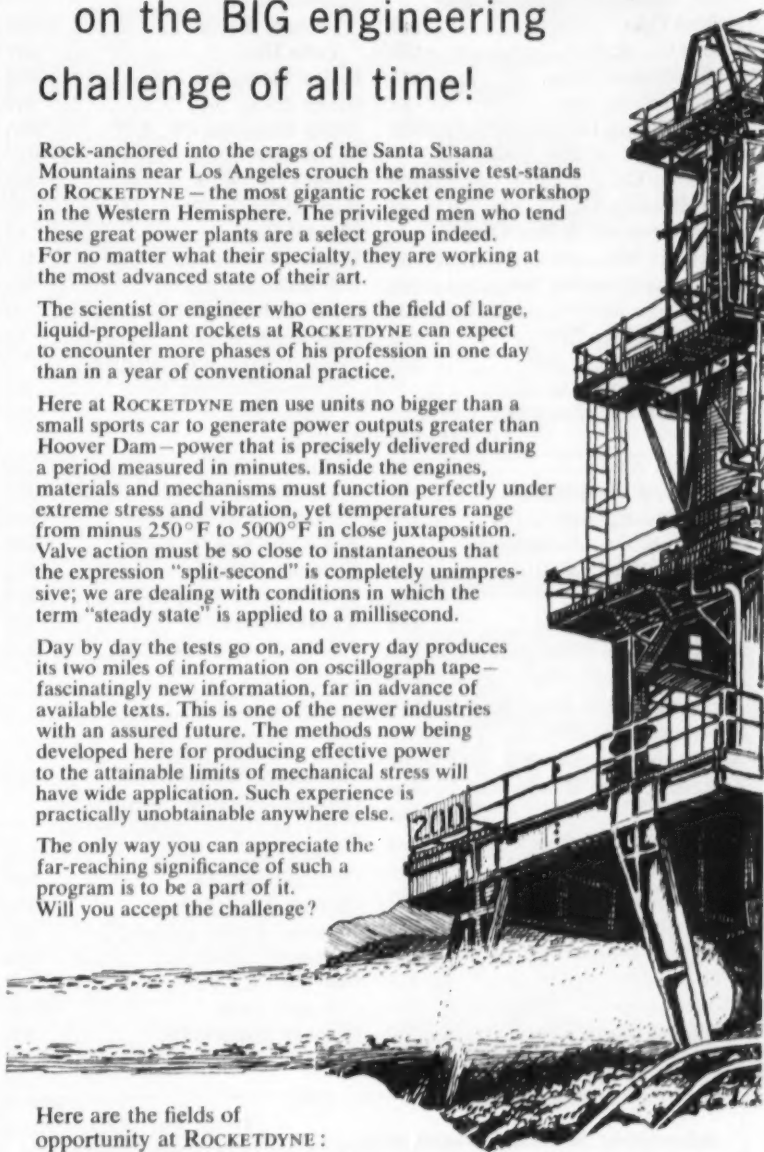
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In Safety

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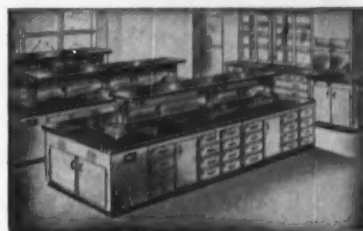
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VALVE CO.**

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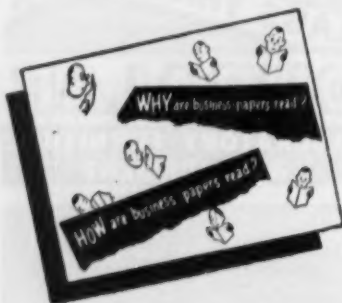
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- RUGGEDLY CONSTRUCTED—Unobstructed Flow
- BLOW-OUT PROTECTED
- SIZES 1-24 inches

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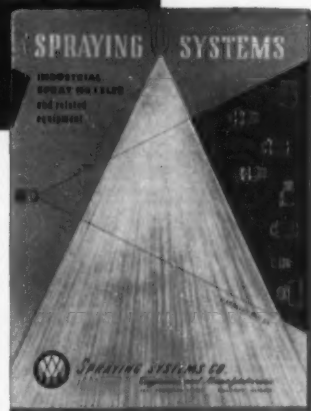
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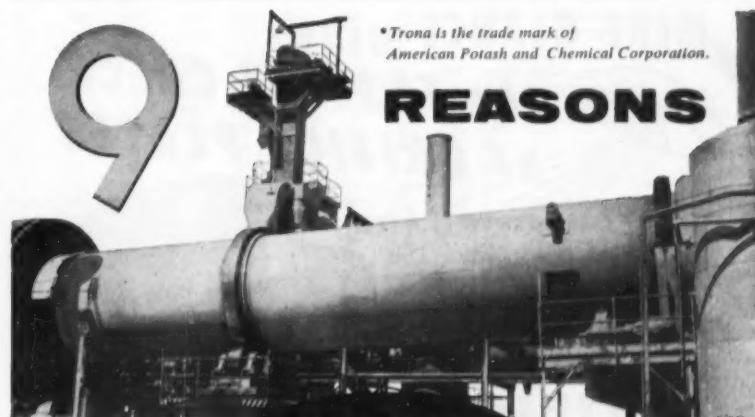
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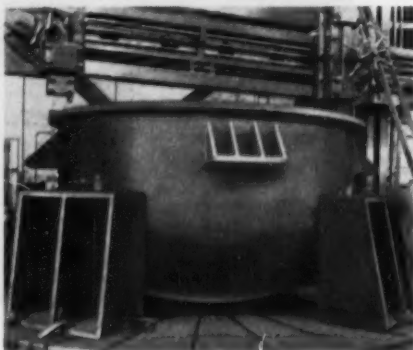
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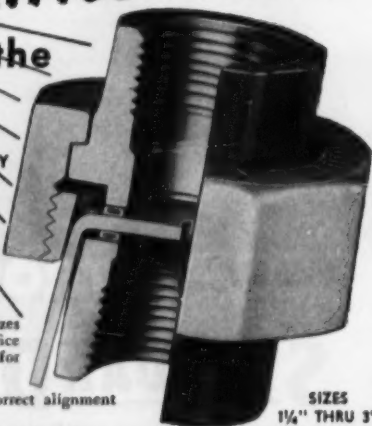
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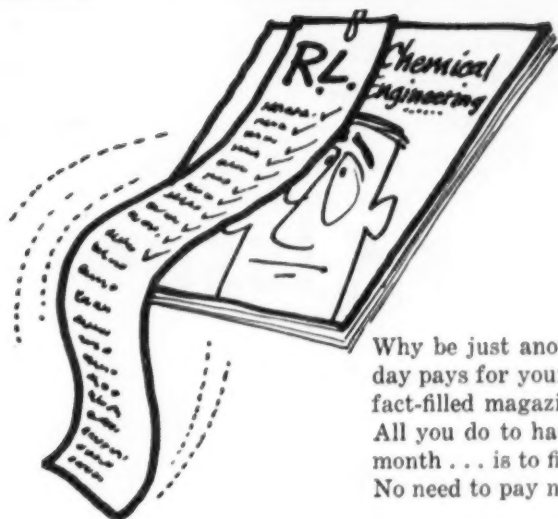
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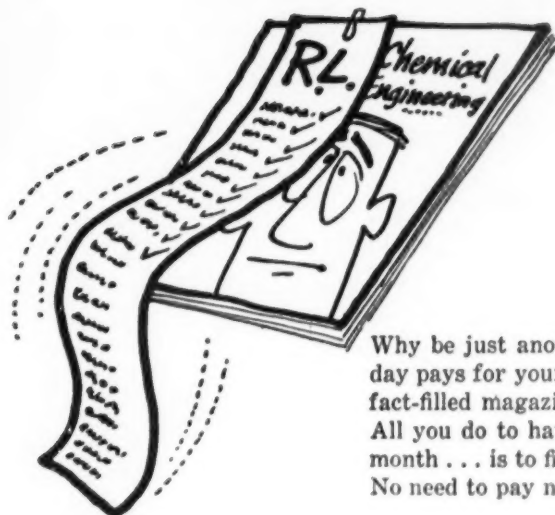
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2	83-3	93	180C	223a	284C	312	349	394	423d	451F	459C	460E	468A	470D
6-7a	86	94	180D	223b	284D	313a	350	395	423e	451G	459D	460F	468B	470E
6-7b	87	95	180E	223c	284E	313b	351	396	423f	451H	459E	460G	468C	471A
6-7c	88	96	180F	223d	284F	313c	352	397	424	451I	459F	460H	468D	471B
8	89	97	180G	226-7	286A	315	352b	398	425	451J	459G	460I	468E	471C
9	90	98	180H	229	286B	316	353	399	426	451K	459H	460J	468F	471D
10	91	99	180I	231	286C	317a	353d	400a	427	451L	459I	460K	468G	471E
11	92	100	181a	233	286D	317b	353e	400b	428	451M	459J	460L	468H	471F
12	93	101	181b	235	287	317c	353f	400c	429	451N	459K	460M	468I	471G
13	94	102	182	236-7	288A	317d	354	400d	430	451O	459L	460N	468J	471H
14	95	103	183	239	288B	317e	355	401a	431	451P	459M	460O	468K	471I
15	96	104	184	241	288C	317f	355a	401b	432	451Q	459N	460P	468L	471J
16	97	105	185	243	288D	318	355b	401c	433	451R	459O	460Q	468M	471K
17	98	106	186	245	288E	319	355c	401d	434	451S	459P	460R	468N	471L
18	99	107	187	247	289	320	355d	401e	435	451T	459Q	460S	468O	471M
19	100	108	188	249	273a	321	355e	402	436	451U	459R	460T	468P	471N
20	101	109	189	250-1	273b	322	355f	403	437	451V	459S	460U	468Q	471O
21	102	110	190	253	273c	323	355g	404	438	451W	459T	460V	468R	471P
22-3	103	111	191a	254A	273d	324	355h	405	439	451X	459U	460W	468S	471Q
24-5	104	112	191b	254B	275	325	355i	406	440	451Y	459V	460X	468T	471R
26-7a	105	113	191c	255a	277	326	355j	407	441	451Z	459W	460Y	468U	471S
28-7b	106	114	192	255b	279	327	355k	408	442	451A	459X	460Z	468V	471T
30-1	107	115	193	256A	281	328	355l	409	443	451B	459Y	460A	468W	471U
32	108	116	194	257	282	329	355m	410	444	451C	459Z	460B	468X	471V
35-6a	109	117	195	258A	283	330	355n	411	445	451D	459A	460C	468Y	471W
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35-6d	112	120	198	258D	286	333	355q	414	448	451G	459D	460F	468B	471Z
35-6e	113	121	199	258E	287-8	334	355r	415	449	451H	459E	460G	468C	471A
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37	115	123	201	259B	289	336	355t	417	451	451J	459G	460I	468E	471C
38-9	116	124	202	259C	290	337	355u	418	452	451K	459H	460J	468F	471D
40-1	117	125	203	259D	291	338	355v	419	453	451L	459I	460K	468G	471E
42-3	118	126	204	259E	292	339	355w	420	454	451M	459J	460L	468H	471F
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44-5c	121	129	207	259H	295	342	355z	423	457	451P	459M	460O	468K	471I
44-5d	122	130	208	259I	296	343	355A	424	458	451Q	459N	460P	468L	471J
44-5e	123	131	209	259J	297	344	355B	425	459	451R	459O	460Q	468M	471K
44-5f	124	132	210	259K	298	345	355C	426	460	451S	459P	460R	468N	471L
46-7	125	133	211	259L	299	346	355D	427	461	451T	459Q	460S	468O	471M
48-9	126	134	212	259M	300	347	355E	428	462	451U	459R	460T	468P	471N

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Indicate quantities for each  
(See page 486)

#### FOR CHANGE OF ADDRESS

(Give both old and  
new address)

Old ☐ Address

New ☐ Address

2	3	4	21	22	25	29	33	34	35	36	37	38	40	42	45	46	47	48	49	50	52	54	55	56	57	58	61
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62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	78	79	80	81	82	83	84	85	86	87	88	89	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Street:

City:

State:

Street:

City:

State:



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